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A History of Post-War Crises—I

A Resumé of Commercial, Industrial and Financial Crises from 1337 to 1860—"Bubbles" of Two Centuries Ago—The First Panics, Their Causes and Effects

By H. H. MANCHESTER

WHERE are prices and wages going? When are they going to reach there? What is going to happen afterwards? Is there going to follow a long period of stagnation, or another period of brisk business?

These are live questions in which we are all vitally interested. To answer them with certainty one would have to be truly a prophet, but it is always possible to reason about the future, even though the conclusion must be based on insufficient data and various "ifs."

What emboldens me to approach the subject is the fact that about a year ago I made a study of the evolution of wage and price levels which was in part published in the *American Machinist*, Vol. 53, page 1123, and Vol. 53, page 389. In these articles, I brought out the fact that the really great changes in wage and price levels in the past had been produced by more permanent causes than wars, and that when the cause ceased to act the effect likewise subsided. In the case of certain catastrophies and wars, I showed that prices had returned to a level about three years afterwards and that this level had usually been about one-third higher than the former basis; while within the same period wages again dropped back but retained more of the rise than prices. From this I argued that we might expect to see wages and prices reach a new level by the beginning of 1922, about one-third higher than in 1914. This article was written when prices and wages were practically at their peak, but both have since shown such a tendency to follow the course outlined that I am encouraged to apply a similar line of reasoning to another forecast.

In my first article I followed the great steps in price and wage levels, which as I have mentioned were found not to be especially post-war effects. In the present article I want to note what actually followed the greatest wars and see if this will not suggest what will take place in the next few years. The finding of a few panics need not worry us, as we have gone through the worst of the present period without a panic and it is morally certain that there is none in sight.

After the Hundred Years' War

There are not so very many wars of world-wide importance and in order to get plenty of examples before us to judge by it will be best to start with the first great war between modern nations, the Hundred Years' War, which was waged between England and France more or less consecutively throughout the century between 1337 and 1436. This ended with the seating through the help of Joan of Arc, of Charles VII on the throne of France. There followed an almost immediate, though comparatively brief, rise in prices and boom in commerce. Wheat jumped from 60 cents a bushel in 1437 to $1.17 in 1438, but receded to 88 cents in 1439 and dropped back to 37 cents in 1440. Thus the period of doubled prices lasted only two years.

In England also, a similar phenomenon took place. In 1436 the price of wheat was 16 cents a bushel; the next year 28 cents and in 1438 it jumped to 44 cents. The next year it dropped back to 23 cents and in 1440 to 11 cents. Other commodities showed an advance though not so strikingly. Wrought board nails, for example, rose from 80 cents a thousand in 1437 to $1.05 in 1438. There is not so very much evidence to judge by in that period, but it is possible that it shows the same sudden, though short-lived, rise after the war which we shall find after other conflicts.

In the Time of Henry of Navarre

Though the religious wars in France which were ended with Henry of Navarre assuming the throne were civil conflicts affecting principally France, it is worth noting that the year after Henry assumed the title of King of France wheat rose from 95 cents a bushel in 1589, to $1.70 in 1590, and to $2.45 for the next two years. It receded to $1.24 in 1594 but in that year the wars were finally settled by Henry's becoming a Catholic and we find another big jump in prices along with a wonderful increase in commerce. Wheat in 1595 rose suddenly to $3.27 a bushel, more than 2½ times what it was the year before. In 1596 it was $3.07 a bushel but the next year dropped back to $1.50.

Following the Thirty Years' War

The next great war, and one which finally included all Europe, was the Thirty Years' War, which began in 1618, and was ended by the Peace of Westphalia in 1648.

In the latter part of the war after Holland had made the treaty with France against Spain, which the Dutch felt practically assured their independence, there occurred in the Netherlands, between 1634 and 1638, one of the most amazing speculations that the world has ever known. A mania for the tulip led to such mad demands for it, that the price of tulips rose to 5,500 florins each. Contracts for them made up the chief business of the country, the rage lasting for four years.

Finally the boom burst in 1638 and the nation plunged into a whirlpool of bankruptcy, the effect of which lasted for several years.

While the greatest effect of the war was experienced in Germany, we find a definite rise in prices after it in France. Wheat, for example, increased gradually from $1.07 a bushel in 1648 to $2.19 in 1651 and dropped back to $1.30 in 1653.

In England this period corresponded to that of the

Puritan Revolution. It is curious that we have a rise in prices in 1646, the year after the battle of Naseby, when it became evident that parliament would win, and another one in 1661 upon the recall of Charles II. Wheat, for instance, rose from $1.04 in 1645 to $1.55 in 1646, and from $1.55 in 1660 to $3.12 in 1661. In 1662 it dropped back to $1.37 a bushel.

Bubbles of Two Centuries Ago

This brings us to the first of the well-known panics which have from time to time disturbed commercial life since the development of the banking and credit system which is so essential to modern business.

The end of the Wars of the Spanish Succession in 1714 left France with an empty treasury and a debt of $500,000,000. The Duke of Orleans, who became regent the next year on the death of Louis XIV, gave John Law, a Scotchman, the right to found a bank and issue notes payable at sight in money at the weight and value of the date of issue. This was the first paper money in France. The plan was at first a great success and helped business in Paris to boom. In 1717 Law formed the Louisiana Company and began to sell shares in it at 500 livres each. New Orleans was founded in 1718 and in December the bank was made a government institution with Law as director. Other companies were united with it and the shares rose to 50 per cent premium. Law made arrangements to take over the national debt and in October, 1719, the shares rose to 8,000 livres. Millions of paper profits were made in speculation and the mania spread to all classes. In 1720, however, it was found that the company could not make profits enough to pay the interest and the crash came. Law was removed as director and fled from France in December.

This might be taken as an isolated case if a similar speculation had not taken place at the same time in England. In 1711 the South Sea Company was formed by Harley to help take up the public debt in return for rights in the South Seas. In 1717 the company began to exchange its stock for short annuities and to loan the proceeds to the government. This at first promised great success and two years later the company offered to buy $800,000 more of the debt a year. The stock rose to 400 and for the first six months of 1720 England was a madhouse of speculation. Many other companies were formed, some of the most amazing character. One was for a purpose which was to remain secret and the shares were sold out in a day.

According to the "Annual Register" of 1720: "The several sums intended to be raised by these airy projects amounted to little less than Three Hundred Million Sterling, a sum so immense that it exceeds the value of all the lands in England."

The South Sea shares reached a price of 1,060 on June 25, but in September the bubble burst and values vanished into air.

The common facts in these developments in France and England seems to be that the close of the war promised an opportunity to exploit new sources of wealth in America which were to relieve the debt created by the war, and that the boom and collapse together occupied only about three years.

After the Seven Years' War

After the war of the Austrian Succession (1740-1748) we find a 40 per cent rise in prices in France which extended over about three years, but a more definite crisis is recorded as taking place after the Seven Years' War, which ended in 1763. This was followed by a remarkable number of failures in Amsterdam, Hamburg, and other great commercial centers of the continent. The crisis extended to England, and Adam Smith says that the Bank of England was compelled to extend support to merchants of more than a million pounds.

It has not been sufficiently emphasized that a crisis occurred both in England and in the United States almost immediately after the American Revolution. It will be remembered that Cornwallis surrendered in 1781 and that peace was signed two years later. In 1782, according to Macleod, the "unfortunate war with America" was terminated, and immediately an immense extension of foreign commerce took place. The Bank of England increased its issues more than 50 per cent between 1780 and 1782, and then became alarmed and violently contracted them. A rapid drain of specie followed, which in 1783 alarmed the directors for the safety of the bank. They continued to contract their loans till October, 1783, when their specie was reduced to 473,000 pounds. Then at last the exchange turned in their favor and specie began to flow in from abroad. As soon as this movement was assured the directors advanced freely on the government loan and to the merchants. Times picked up soon afterwards and exports and imports doubled in the next ten years.

In the United States, according to Weeden, ordinary commerce with the West Indies and Europe was resumed with a rush as soon as peace was assured. Glut succeeded famine and in the autumn of 1784 the importing and commission stores were filled with unsold European goods. In Boston imported wares were offered freely at two or three per cent over cost and charges, and by the summer of 1785 the goods were lying idle, customers could not pay for their purchases, and responsible merchants were getting their debts extended in England.

An important effect of this was the passage of protective tariff acts by Rhode Island, Massachusetts, and Pennsylvania, which perhaps helped times to pick up at the end of 1786. This crisis had an epoch-making result in convincing the states of the confederation of the necessity, for economic reasons, for a more efficient union; and as a matter of fact times were much improved after the forming of the Constitution in 1789.

The Hamburg Crisis of 1799

A serious panic took place in England in 1793, but as this was caused by the beginning of the war with the French Revolutionists, rather than an event subsequent to any war it is outside of our subject. So are likewise several more or less serious crises which took place during the Napoleonic Wars.

There was a crisis in Hamburg in 1799, however, which from our present viewpoint deserves especial notice. This crisis was caused by the French occupation of Holland in 1795 which threw into the hands of Hamburg the continental trade which had previously gone to Holland. This caused a tremendous speculation, rise in prices and extension of credit in Hamburg, which lasted for four years. Then the crash came and 82 houses failed.

A good account of conditions immediately following the termination of the Napoleonic Wars, is preserved in Tooke's "History of Prices," and runs in part as follows:

"While the events were in progress which led to the

restoration of the Bourbons and the peace of Europe in the spring of 1814, the speculation in exportable commodities which had its first rise in the dawning prospects of the emancipation of the Continent at the close of 1812 and the beginning of 1813, reached its height. The prices of all colonial produce and of other articles of export including . . . many descriptions of manufactures which had long been waiting a market advanced very considerably, some beyond all precedent. The extraordinary demand arising out of that speculation for the manufactures of this country occasioned such an extra employment of workmen in the manufacturing districts as entitled and enabled them to command a considerable advance in wages.

". . . A reverse from speculations so entered into and conducted . . . was inevitable.

"The shippers found to their cost when it was too late that the effective demand on the continent for colonial produce and British manufactures had been greatly overrated; for whatever might be the desire of the foreign consumers to possess articles so long out of their reach, they were limited in their means of purchases, and accordingly the bulk of the commodities exported brought very inadequate returns. The low prices which alone the consumers abroad were able to pay, were still further reduced in value by the advance in our exchanges. . . . And it is a well-known fact that the losses upon a large proportion of the goods shipped to the Continent were . . . not less than fifty per cent."

As Lord Brougham put it, the exported goods "were selling for less in Holland and Germany than in London and Manchester; while in most cases they were lying at dead weight on the market without any sale at all." As a consequence 6,616 failures took place, and many thousand workmen were thrown out of employment.

Times got better at the end of 1817 and during the next year, only to be followed by another crisis which was so severe that the Bank of England was again forced to suspend specie payments.

In the fall of 1820, however, business recovered. Specie payments were resumed by the Bank of England May 1, 1821, and the annals of the time show that England continued to be highly prosperous until 1825.

In the United States the termination of the Napoleonic Wars coincided with that of the War of 1812. This was followed by conditions which in many ways were the parallel of those in England. "The very moment the blockade was lifted," according to MacMaster, "a mass of domestic produce poured forth on the markets of Europe long waiting to receive it. . . .

"Sure that a time of prosperity was coming, the merchants, before the contents of the treaty were known . . . began to prepare for an immense trade. Crews were engaged, ships were chartered, cargoes were advertised for, and calkers, riggers and sail makers were in such demand that four dollars for ten hours' pay was freely offered in the great cities."

Toward the end of May great fleets of ships began to come in with huge quanities of silks, satins, muslins, brocades, hardware, tools, coffee, tea and other things which must still be had from abroad or not at all. These were hurried to the auction block, where enormous prices were secured in consequence of the buyers bidding against each other. Eventually, however, the demands were satisfied and the eagerness to buy began to subside with the result that a stimulus was given in the form of credit.

This over-competition shut up many of the American factories which had been established during the war, while at the same time customers could not pay for the goods they had bought. The consequence was disastrous to both England and the United States. Business improved in 1817 and 1818, but nevertheless remained on a precarious foundation.

Conditions were made much worse by the wildcat paper money which was issued by the banks without any security behind it. Combined with overspeculation in the new lands in the Middle West, this produced a panic in 1819 which closed many of the banks and reduced both prices and wages.

The Crisis of 1825

At first sight it might seem that the crisis of 1825 in England was not an after-the-war effect, unless perhaps it was a "second-barrel" explosion following ten years after the close of the Napoleonic Wars. Detailed accounts of the period, however, indicate that it was a direct result of the revolutions in South America which freed the colonies there from Spain.

The crisis became severe in November 1825 and was made worse by the failure of two large banking houses on Nov. 29. A panic was precipitated when the great banking institution of Pole, Thornton & Co. in London stopped payment. The failure of sixty-three country banks followed. At first the Bank of England was too niggardly in its advances, but on Dec. 14 it totally changed its policy, and began to discount liberally on good security. The London panic stopped in two days.

The panic was still under way in the country towns, but the Bank of England luckily found an almost forgotten chest of between 600,000 and 700,000 one pound notes which it sent to the country banks. These notes were remarkably successful in allaying the panic in Scotland and outside of London, and in banking circles the worst of the trouble was over in a few months.

In industry, however, the recovery was slower. The king's speech in parliament of Nov. 21, 1826, said of the situation: "The depression under which the trade and manufactures of the country have been laboring, has abated more slowly than I thought myself warranted in anticipating."

Of 1827, the "Annual Register" spoke more favorably: "The internal state of the country at the opening of 1827 was much more cheering . . . the different monied and manufacturing interests of the kingdom likewise were rallying from the confusion of the preceding eighteen months by a progress, which though slow, was sensible and sure."

Conditions were apparently much improved in 1828, as the failures in England numbered only 1,223 as against 2,583 in 1827.

In the United States there was no crisis in 1825 comparable with that in England. The slump in conditions there, nevertheless seriously affected the cotton industry here, which after a boom in the first part of 1825 was hard hit at the end of the year.

The difficulty of the English woolen manufacturers led them to ship vast quantities of goods to the United States. As in 1816, these goods were sold at auction for what they would bring. Such competition for example forced down the price of broadcloth from $4.50 in 1824 to $2.60 in 1826 for the same quality and almost prostrated the woolen factories here. The indirect result was the high tariff of 1828 which led to an attempt at nullification by South Carolina.

There was a severe crisis in both England and the United States in 1837, but it was not a post war crisis. In the United States it was largely due to speculation in canals and western lands and was made much more severe by the unsecured paper money of the wildcat banks. The hard times continued until after 1840.

In England there was heavy speculation in canals, joint stock banks, and the newly introduced railroads. The crisis there was increased by the failures in the United States, and was probably worst in 1839.

The crises of 1847 in England followed a tremendous speculation in railway and other improvements. Sixty-five railway bills were pased in one day in 1845, and concession was the business of the hour. The panic was over in 1848, and trade was again normal in 1849.

The British Crisis of 1857

Trail, in his "Social England," states that the War of England and France against Russia produced a period of speculation in England which left her open to a crisis. In his words: "The Crimean War (1854-56) gave an artificial stimulation to trade, and in 1855 confidence passed far beyond the bounds of prudence. Credit began to be recklessly given. Many large operators kept practically no reserve, trusting to the Bank of England to help them."

The crisis came on suddenly. As stated by the "Annual Register": "When parliament was prorogued at an unusually late period in the summer, it was little thought any occasion would arise for its reassembling before the customary time in the following year. But late in the autumn of 1857 . . . a monetary crisis of great severity . . . spread embarrassment and consternation among the mercantile classes of the comunity." On Nov. 9, the Western Bank of Scotland failed with its ninety-eight branches. The bank act of 1844 had to be suspended, and the Bank of England permitted to issue one million pounds more in notes than the law would have allowed. A crash in prices followed which affected all industries.

The recovery from this crisis must have been rapid, because the *London Times* said of 1858, "Never were there more threatening contingencies than on the first of January, 1858, yet they have all disappeared, and we commence the new year (1859) without a single point of disturbance."

The Crisis in Europe

A similar crisis also took place in France, Germany, Austria, Belgium, and Scandinavia. In several of these countries the foundation was laid by the speculation during the Crimean War, but the crises was made worse by the panic in the United States.

In the United States the crises of 1857 was undoubtedly caused by the over expansion of the railways, of which 16,000 miles were constructed between 1850 and 1857, and is, therefore, outside our subject. It may be noted, however, that prices dropped 30 per cent. The recovery the next year was slow. The *Bankers' Magazine* of January, 1859, stated: "A gradual improvement has taken place, and the manufacturing interests of the country are again awakening to a more profitable condition." By 1860 the recovery must have been complete, for the *Bankers' Magazine* declared of the months before the election, "No previous year has exhibited stronger indications of prosperity among merchants, manufacturers, capitalists, and the great agricultural interests."

Handy Polishing Sticks

By W. T. Elzinga

While serving my apprenticeship in instrument making, my employer and teacher used a kink for polishing that has proved to be very useful in the machine shop, toolroom and pattern shop. It is more economical and workmanlike than the old method of holding a strip of abrasive cloth on a file or glueing it to a stick. It may not be new to men of the old school; to others it may be of help.

Make an assortment of sticks from ½ in. to 2 in. wide, ¼ in. to 1 in. thick and 16 in. long. Round up 5 in. to fit the hand comfortable. Plane the working surface of the other 11 in. about 1/16 in. convex lengthwise and bevel sides and end from 5 to 10 deg. For polishing undercut surfaces, bevel sides as much as needed.

Put a coat of beeswax on the working surface by rubbing it with a lump of this material, spreading it evenly. For polishing metals, cut off a strip of emery cloth the width of the stick and the whole length of the sheet (11 in.) or use roll aloxite or sandpaper when working in wood.

Place this strip on the working surface, rest the abrasive on a piece of about 1-in. cold-rolled steel and roll it back and forth a few times, while pressing it evenly, and you have an excellent polishing file for flat and curved surfaces. It is not very good for lathe work unless used very carefully.

To replace the abrasive simply tear off the worn strip and roll a new one in place.

This scheme works equally well on wooden polishing disks on the speed lathe, except that one must use a metal or wooden roller held in a forked handle to press the abrasive cloth in place.

Are Hollows Worn in Hammer Handles by the Fingers of the User?

By L. L. Thwing

Some time ago I saw an advertisement in one of our popular weeklies, showing a ball pein hammer, the handle of which showed three or four hollows. The accompanying reading matter stated that the hammer from which the photograph was taken had been through the war, and had seen long and severe service in France; in proof of which it pointed to the hollows in the hard hickory handle where the user had worn the impression of his fingers.

Recently I read an article recounting the average length of continuous employment in a certain factory. One of the workers—a glass setter—showed the writer of the article a hammer which had been used so long that deep grooves had worn where his fingers gripped the handle.

Now, while I am very skeptical about the possibility of any such wear as this actually happening, and I certainly never saw a hammer handle so worn, it is not impossible under some circumstances, as, for instance, where a man's hand was continually covered with some gritty substance.

In the case of the first mentioned hammer handle I am quite sure that the notches were cut to prevent slipping when held in a greasy or cold-stiffened hand; and in any case the proper way to hold a hammer is not to grip it as hard as possible, but rather quite the contrary.

Has anyone seen a hammer handle that showed finger prints or other wear from the friction of the hand?

An Improved Method of Making Steel Gear and Wheel Blanks

Producing Parts from Steel Ingots—Making a High-Grade Steel Gear Blank in One Minute —Utilizing the Hydraulic Ram for Production Work

BY GEORGE ATWELL RICHARDSON
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MODERN mechanical equipment must stand up under service conditions that tax even the best of materials, and the search is ever for something still better. The object of this article is to describe an improved method of manufacturing gear blanks, industrial wheels, car wheels, automobile flywheels and similar uniform circular sections that are of superior quality in every way and will meet the most severe service requirements.

FIG. 1. CROSS-SECTION OF 22x22-IN. INGOT BEFORE ROLLING. FIG. 2. BLOCK SHEARED FROM BLOOM PRODUCED BY ROLLING 22x22-IN. INGOT

It is a recognized fact that thorough working at the proper temperature is one of the most important factors in improving the quality of steel. This thorough working in the present method is largely, though not entirely, secured by the combination of a rolling and forging operation in one machine.

The best way in which to describe the manufacturing operations is to begin at the beginning and follow through step by step.

A 22-in. x 22-in. ingot, a cross-section of which is shown in Fig. 1, is rolled down into a large round or bloom, the diameter of which will ordinarily be 11 in. to 15 in., according to the section to be made. Right here at the start there is a reduction in area amounting to from a maximum of about 80 per cent of original area to a minimum of about 65 per cent. This bloom, while still hot, is then cut up into cylindrical blocks or blanks (see Fig. 2) with the aid of rotary shears, the size again depending on the section that is to be made. The rotary shearing machine, with a bloom (which has just been rolled from the ingot) ready to enter, is shown in Fig. 3.

A chipping operation is now performed, after which the blocks are carefully inspected and then taken to a re-heating furnace where they are brought to the proper forging temperature. Then follows a minor operation which consists in punching one end of the blocks as shown in Fig. 4, for the insertion of a mandrel or rolling pin used to hold them in place during the next

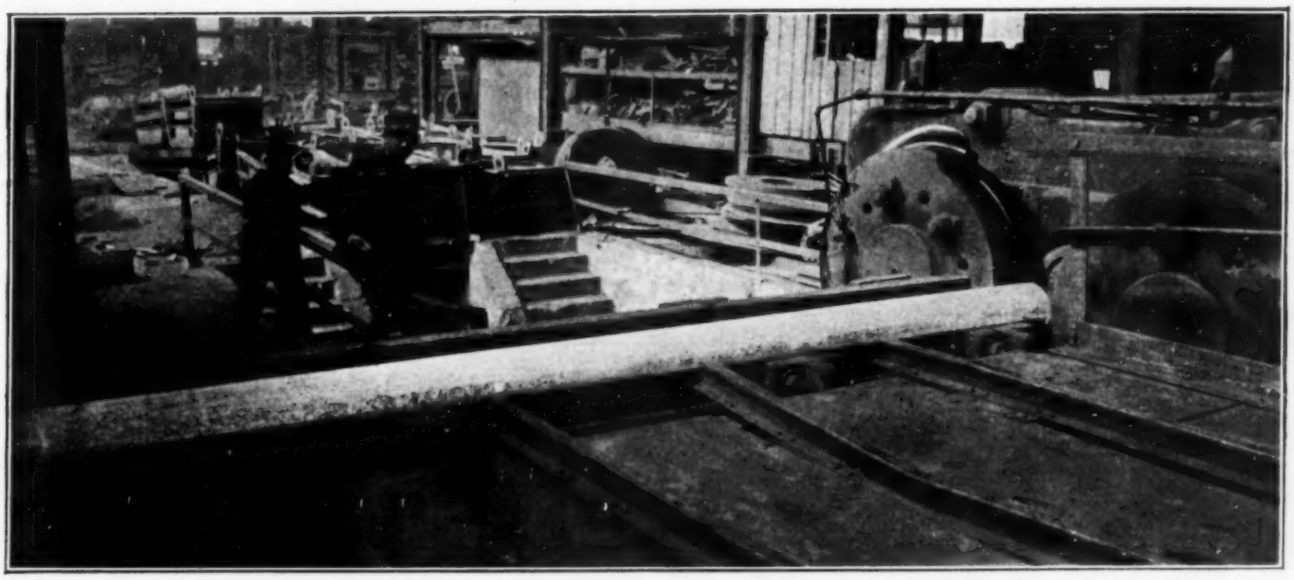


FIG. 3. ROTARY SHEAR WITH BLOOM READY FOR SHEARING

FIG. 4. BLOCK PIERCED FOR INSERTION OF MANDREL. FIG. 9. FIG. 9. BLOCK AS IT APPEARS AFTER START OF ROLLING OPERATION

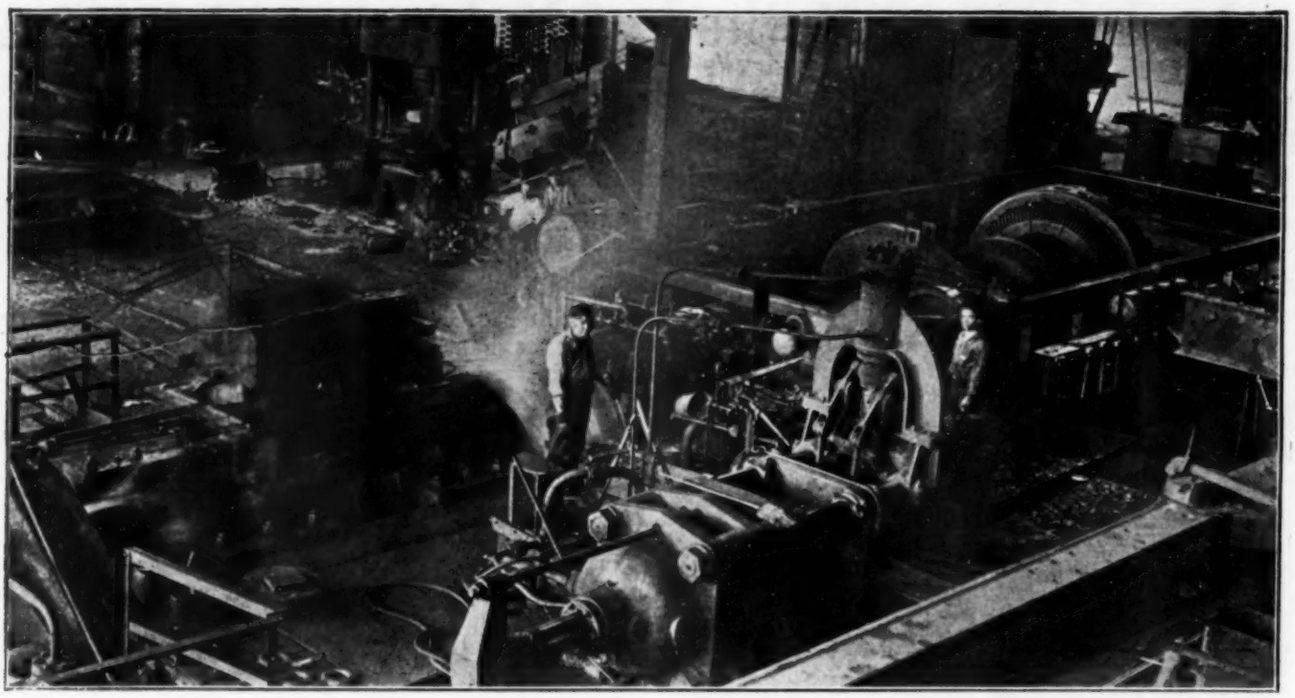


FIG. 5. GENERAL VIEW OF EQUIPMENT; HORIZONTAL PUNCH PRESS IN FOREGROUND; HYDRAULIC RAM AND DRIVING MECHANISM SHOWN; RAM END IS INDISTINCT, DUE TO VIBRATION

stage of manufacture. This stage is the most important one in the method described, but before taking it up in detail, it is necessary to give a short description of the special machine or mill used.

This tremendous piece of mechanism, which is illustrated in Fig. 5, has an overall length of 70 ft., width of 18 ft. and height of 14 ft. It consists of the following important parts, the relative positions of which are shown on the drawing in Fig. 6.

B is a die which is mounted on the end of an hydraulic ram *A* in such a manner that it is free to rotate. *C* is a second die with its axis of rotation at a small angle to that of *B*. This second die is mounted on shaft *D* which is driven by a 2,000-hp. electric motor.

The ram has a pressure plunger 38 in. in diameter, developing a maximum pressure of 3,000,000 lb. The cylinder housing is about 18 ft. wide by 14 ft. high overall and weighs more than 50 tons. The total weight of the entire mill without motor or driving mechanism is 400 tons. These figures give a good idea of the massiveness of the equipment and prepare the reader for the description of the actual manufacturing operation which follows:

The block, which has not had a chance to cool from the forging temperature since punching, is placed in position between the dies, and then by a combined rolling and pressing operation, the metal is gradually worked out until it fills the dies and takes on the shape

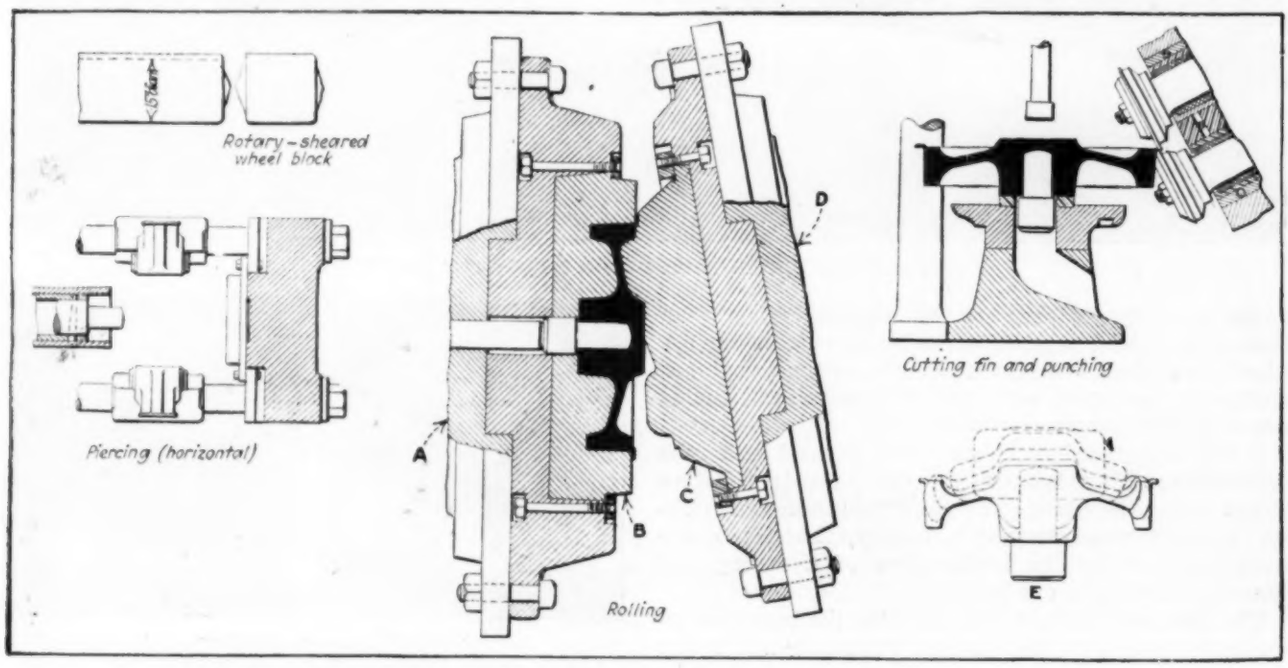


FIG. 6. DIAGRAM SHOWING PROCESS OF MAKING PARTS WITH HYDRAULIC RAM

desired. Die *C*, which is the driven die, rotates the block and die *B* in turn by friction. Die *B* is fed forward by the hydraulic plunger. The angularity of the dies is for the purpose of producing the rolling or kneading action, the rolling and pressing as mentioned proceeding at the same time. Fig. 7 shows the mill with a blank in position ready for pressing and rolling, and Fig. 8 shows the same blank after it has been rolled. The total operation on this mill takes from 30 sec. to 1 min. according to the size of the piece being made. The blank as it appears during the different stages of the foregoing operation is shown in Figs. 9, 10 and 11.

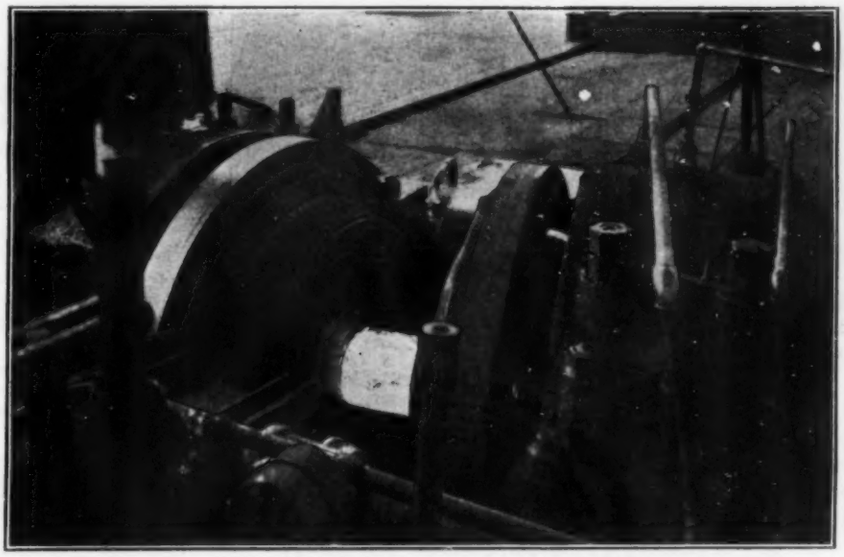


FIG. 7. MILL WITH BLANK IN POSITION READY FOR PRESSING AND ROLLING

The blank is now practically in the completed condition except for a few minor operations. These include shearing a thin fin which extrudes, punching the hub, stamping identification marks and a certain amount of machining which depends on the customer's specifications. Fig. 12 shows a completed blank with the fin sheared off, and another, on which some of the rough machining operations have been performed is shown in Fig. 13.

It is difficult to visualize the exact flow of the metal between the dies during the manufacturing operation but diagram *E* in Fig. 6 gives some idea of the transition from block to blank. In general it can be said that as the metal is squeezed down it flows out from the middle in a parobolic path. As can be seen the steel receives an unusual amount of working in this one operation alone.

Advantages and Disadvantages

These few facts very briefly describe the methods of manufacture. No attempt has been made to go into great detail, only those things being mentioned that give a good idea of the size and character of the equipment and the actual working that the steel receives.

Several questions that arise are the following: (1) What sizes and kinds of sections can be made by this method? (2) What are the advantages? (3) What is the comparative cost?

A general statement as to sections rolled is that any uniform circular section weighing not less than 100 lb. can be made by this method. Sections lighter in weight cannot be economically made, and there are inherent manufacturing difficulties as well. The maximum limits are variable. Turbine bucket wheels up to 48 in. in diameter have been successfully produced although for car wheels 30 in. is the maximum diameter recommended for making by this method. Among the various sections which can be rolled are: Automobile flywheel blanks, band wheel flange blanks, bevel roller blanks, gear blanks such as bevel, spur and gear ring blanks, mill and railway motor blanks, blanks for truck and tractor transmissions, etc; car wheels, industrial wheels, double-flange crane track wheels, pipe flange blanks, piston blanks, shaft coupling blanks.

The advantages of using blanks made by this method are numerous and include the following:

(1) First and most important is the fact that the steel receives an unusual amount of working at the proper temperature, which puts it in the best possible condition.

(2) The steel is of uniform density throughout, thus insuring superior static and dynamic balance when blanks are machined.

(3) The metal is homogeneous. There are no blow holes, shrinkage cavities, etc., to contend with.

(4) As compared to castings, there is no scrap loss due to defective pieces.

(5) There is no hard or sandy scale to contend with. Machine shop costs are thus materially reduced.

(6) That part of the steel which receives the most working is at the circumference where the actual service is sustained.

(7) The center of the bloom always remains parallel to the center of the original ingot and since any piping

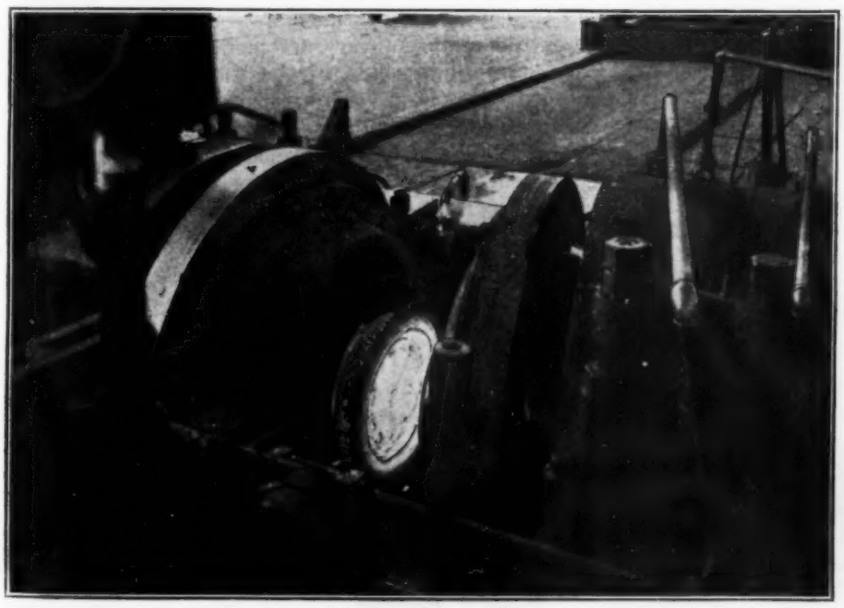


FIG. 8. MILL SHOWING BLANK AFTER IT HAS BEEN ROLLED

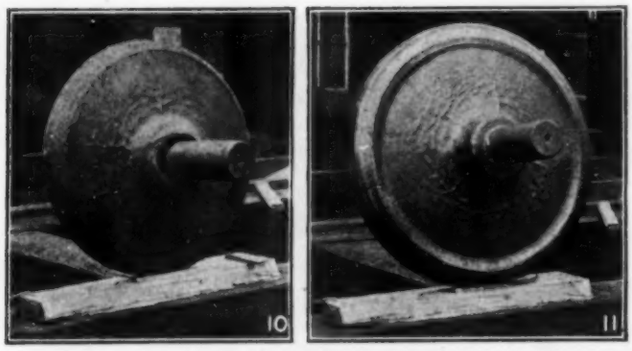


FIG. 10. BLOCK WHEN ROLLING IS HALF COMPLETED
FIG. 11. BLOCK AS IT APPEARS WHEN METAL JUST BEGINS TO TOUCH EDGE OF DIE

or segregation is in the center of the ingot it also is in the center of the bloom and of the blocks cut from the bloom. This is due to the fact that the ingots are rolled longitudinally. In shaping the block, the flow of metal as mentioned is outward from the center, the least movement being at the center. Thus the piped or segregated material remains in the hub and is either punched out or is in a position where it does no harm.

(8) Steel of any ordinary range of carbon content or specification can be used, thus making it possible to provide for oil hardening or other special treatment with the resultant advantages.

(9) There are no shrinkage stresses to cause breakage due to shock in operation.

(10) Blanks made by this method have the inherent superiority of steel that has been forged and worked.

Some Interesting Tests

In this connection some interesting experiments were made recently which throw some light on the superiority of gears made from blanks manufactured by the method described. The first test was made to compare the strength of the teeth of a cast-iron gear, a steel gear as rolled and a steel gear which had been heat-treated. The second test was a drop test—a cast-iron gear and a steel gear made from the blank as rolled but without any heat-treatment being used.

The gears were all 21½ in. in diameter and identical in size, shape, style of teeth, etc.

In the first test the results shown in the table were obtained:

Gear tested:	Breaking Strength of Teeth First Test	Second Test	Remarks
Cast-iron	7,515 lb.	10,720 lb.	Teeth would not bend.
Steel gear, steel as rolled	32,395 lb.	34,310 lb.	Teeth bent at these loads.
Steel gear, heat-treated	40,750 lb.	42,600 lb.	

In the drop test equally interesting results were obtained. The cast-iron gear was tested under a drop testing machine with a 200-lb. tup falling from a height of 6 ft. The gear broke into four pieces on the first blow of the tup.

The steel gear in which the steel was in the natural condition, that is, not heat-treated, was tested in the same manner. After dropping the weight twenty times from a height of 6 ft. there was a deflection of about ⅜ in. and some distortion of the rim but no signs of breaking had appeared.

From these tests it will be seen that there is a remarkable difference in strength between the cast-iron gears and the steel gears.

The Question of Costs

What is the comparative cost of sections made by this method? This is a question that cannot be given a general or off-hand answer, because so many factors

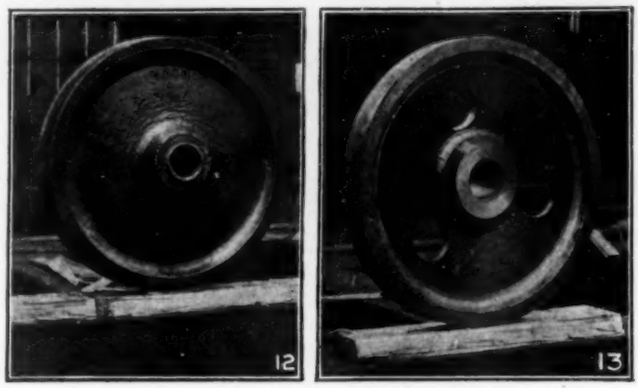


FIG. 12. COMPLETED BLANK WITH FIN SHEARED OFF
FIG. 13. BLANK AFTER ROUGH MACHINING

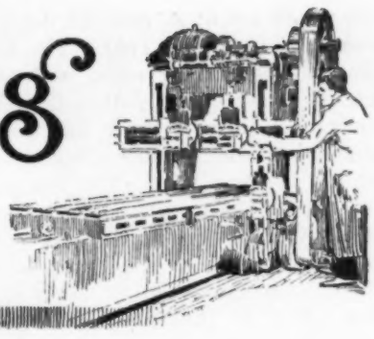
must be considered. The shape and size of the blanks, the number required and other like things necessitate giving each proposition considerable individual attention. As might be expected, the first cost is naturally larger than that of castings, but the final cost after machining and getting ready for use is what counts.

As a rule when the elimination of scrap losses, reduced machining required, etc., are considered, the finished cost is very nearly, if not quite, as low as that of castings. In fact, some manufacturers have gone so far as to say that they make the finished pieces at less cost. In this connection it must not be overlooked that the longer life and superior service given have a very definite if intangible value in the way of advertising and satisfied customers.

On the whole, the arguments are all in favor of this method. The general trend in modern design is helping in this direction, and it seems certain that the worked steel parts will supersede cast parts in many forms of mechanism where service and stand-up ability are of prime importance.

Metal Cutting Tools.

By A.L.DeLeeuw



XI. Cutter Sharpening—Characteristics of Cup and Disk Wheels—Importance of Correct Angles—Cutter Grinders—Hob Grinding

PROPER sharpening of cutters is of as much importance as their design, or the material of which they are made. The requirements for good cutter sharpening are much the same as those for the grinding of other tools, with some features added. It will be taken for granted in this article that the reader is familiar with the methods commonly in use, and the machines used for the grinding of cutters, so that only those points will be mentioned which are not entirely obvious.

As with other tools care should be taken to get the angles correct. Until a few years ago it was necessary to go through a good deal of trouble to set the machine so that the desired angle would be produced, but nowadays machines may be had which permit of setting up for any clearance desired without any preparatory calculations.

The first question presenting itself is the shape of wheel to be used. Is it better to use a cup or a disk wheel? To answer this question intelligently let us see what happens when we use either of them.

Fig. 176 shows a section of a cutter of which part of the tooth has been shown in a diagrammatic way. The tooth has been deflected so as to present the proper clearance angle to the cup wheel. Fig. 177 shows the same cutter but another tooth is shown besides the one to be ground. Instead of the cup wheel a line *XY* is shown. This line represents the intersection of the plane of the front of the cup wheel with the plane of the paper. As the drawing shows it, the cup wheel

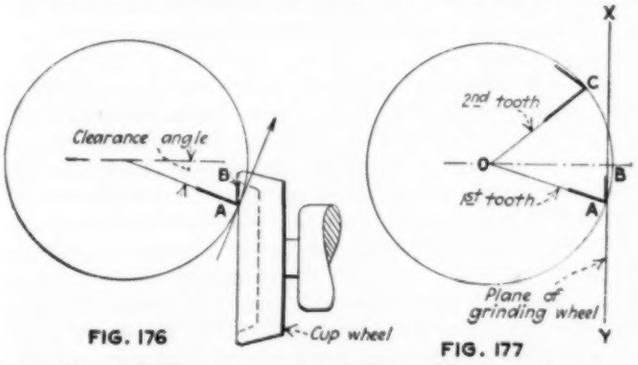


FIG. 176. CUTTER AND CUP WHEEL. FIG. 177. DIAGRAM TO SHOW RELATION BETWEEN TOOTH SPACING AND CLEARANCE ANGLE

would grind tooth *A* but would clear tooth *C* so that it would not make any difference whether we set the cup wheel high or low. In order to have this condition angle *COB* must be greater than the clearance angle *BOA*. In other words, angle *COA* must be greater than twice the clearance angle. This angle *COA* is the angle between two adjoining teeth, so that we may say that as long as the angle between the teeth is more than twice the clearance angle we do not need to pay attention to the height of the cup wheel. In other words, at whatever height we may set the wheel, it will grind a tooth without interfering with another.

If, on the other hand, the angle of spacing between the teeth is less than twice the clearance angle, we must take care that the top of the cup wheel comes below the next tooth. This is so simple, and is so easily seen by the man who grinds the cutter, that it would not have been mentioned here but for the fact that it has important bearing on the result of the grinding. In Fig. 179 a cutter is shown under the conditions of Fig. 177, that is, under conditions where the cup wheel cannot interfere with the next tooth. The portion *ACBD* is that portion of the tooth which is being sharpened by the wheel. The wheel being made up of little grains cannot possibly make a smooth edge but will produce an edge somewhat like that shown in Fig. 179A. Of course, the matter is grossly exaggerated in the illustration, and the serrations will be much smaller and less regular in size, but the main fact remains that there will be a serrated edge as the result of the grinding.

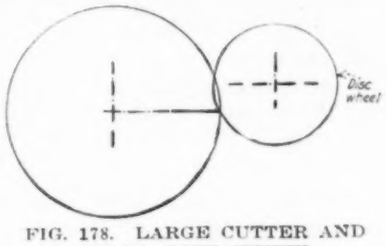


FIG. 178. LARGE CUTTER AND SMALL DISK WHEEL

These serrations, if not too coarse, do no harm. As a rule, they are not deep enough to weaken materially the edge of the cutter, so that we may say that with a cup wheel set in such a manner that its center is in the same horizontal plane as the edge to be ground, satisfactory results will be obtained. This matter becomes entirely different if we have to set the wheel somewhat as shown in Fig. 176, where the center of the wheel is below the edge to be ground. The serrations are no longer at right-angles to the cutting edge, but are as shown in Fig. 180. In order to see if this will make any difference in the action of the cutter, we will take a strong magnifying glass, and examine the serrated edge produced under these conditions.

Fig. 181 shows this edge looked at in the direction of the arrow in Fig. 176, the full lines showing what

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we would see at *A*, and the dotted lines what we would see at *B* (see Fig. 176). The full line, being the outline of the cutting edge, will reproduce itself when a cut is taken. The dotted line, being the section further back, should clear the work. As the imaginary diagram shows, it does clear the work at some, but not at all, points. Where the full and dotted lines of Fig. 181 cross there will be interference; in other words, the cutter will act at those points as if it had no clearance, or rather, as if it were made with negative clearance. Such a condition would cause the breakdown of the cutter at that point. It makes no difference that the serrations are very small and that there is negative rake at a few points only, the result will be the same as if this condition existed on a large scale. We find, then, that the wheel should be central with the edge to be ground, at least nearly so. If we wish to grind a cutter with 8-deg. clearance, the angle between two adjacent teeth should be more than 16 deg. In other words, the cutter must not have more than 22 teeth. This happens to be the case in all wide spaced cutters of ordinary size, only cutters of very large size would have more than that number of teeth. It follows, then, that a cup wheel can be used for all ordinary plain milling cutters. What will be the case, however, when we wish to grind a spiral cutter?

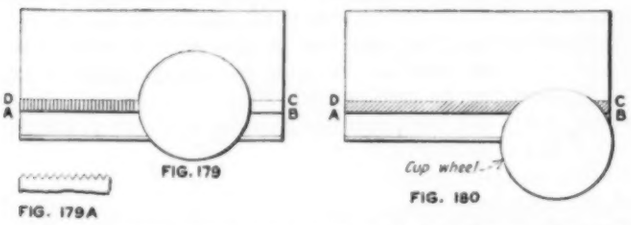


FIG. 179. SIDE VIEW OF CUTTER AND WHEEL, WHEEL CENTER IN LINE WITH GROUND SURFACE. FIG. 180. SAME BUT WITH WHEEL CENTER BELOW GROUND SURFACE

What will happen in this case is shown in Fig. 182 in diagrammatic form. The cutter is being ground at the point *M*. The outside of the rim of the cup wheel is represented by the full circle, while the inside of the rim is shown by a dotted circle. The next tooth is represented by *PQRS*, and, as we have seen, point No. 1 of that tooth will clear the wheel. Point No. 2 might also clear the wheel and so might point No. 3, but finally a point would be met, somewhere on tooth *PQRS*, which would interfere with the wheel if the wheel were solid. As the wheel is hollow, it makes the chance of interference less, but does not entirely avoid it; so that it is possible that the wheel would touch tooth *PQRS* somewhere. If this happens at point No. 6, which is located on the same horizontal line as point *M*, no harm results, but if it happens anywhere above that line, a point of tooth *PQRS* would be ground to a smaller diameter than the one desired.

Whether this will actually happen or not depends on the distance between the teeth, the angle of spiral, the diameter of the cutter, and also the length of clearance we aim to produce. A small angle of clearance, a small number of teeth, a small angle of spiral and a small cup wheel will minimize this danger. If such an interference occurs it is necessary to lower the center of the wheel and slanting scratches will be produced.

Now let us see what conditions we will meet if we use a disk wheel. This set of conditions is diagrammatically shown in Fig. 183, where the circle *O* represents the cutter, and circle *F* the disk wheel. Angle *AOB* is the desired clearance angle. It will readily be seen that the wheel will clear the next tooth if the

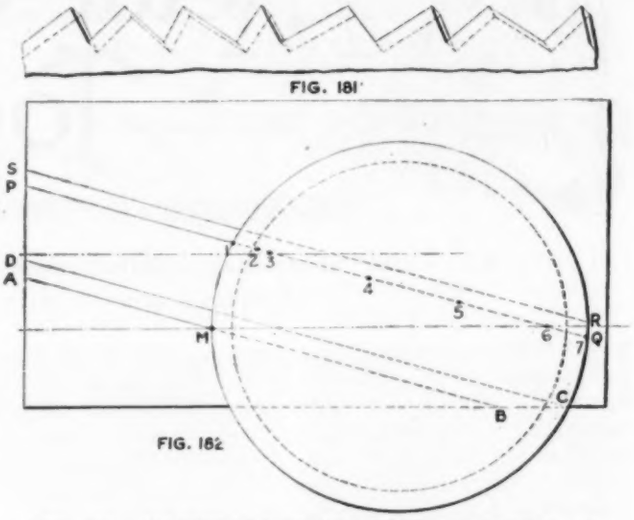


FIG. 181. MAGNIFIED VIEW OF EDGE GROUND AS IN FIG. 180. FIG. 182. SPIRAL CUTTER GROUND BY CUP WHEEL

clearance angle is less than half the angle of the spacing of the tooth. This condition is even better than with the cup wheel, because the circumference of the wheel retreats from the cutter, so that, with an angle of clearance not less than, but equal to, half the angle of spacing, there would still be no interference. Furthermore, all we would have to do, if such interference took place, would be to use a smaller wheel.

When a spiral cutter must be ground the disk wheel shows up still better in this matter of interference. The cup wheel caused trouble because it had considerable width at the point where the grinding took place. A disk wheel, such as is used for cutter sharpening, is narrow, generally not more than $\frac{1}{2}$ in. and hardly ever more than $\frac{3}{4}$ in. wide, so that there is no danger that it will strike a point on the spiral of the next tooth.

If nothing else but interference had to be considered the disk wheel would have the advantage all along the line. Furthermore, the disk wheel does not make slanting scratches, so that, here again, the advantage lies with it. However, there are other considerations which, as will be seen, modify the relative advantages of cup and disk wheels.

Fig. 178 shows a relatively large cutter and small disk wheel. It shows the concave form of the edge of the tooth. If the tooth were somewhat wider there would be created a condition where the back of the tooth would be the same, or even of larger diameter, than the front of the tooth, so that the back of that tooth would interfere with the work. This is, of course, exaggerated, and such a condition would not be found in practice, but what is found, and quite often, is that the clearance between the back of the tooth and the work has been materially reduced and that the concave tooth acts as a kind of reservoir for fine chips. In other words, the cutter does not keep itself clean, and the tendency for small chips to weld themselves into the tooth is much greater when the cutter is ground with a disk than with a cup wheel. This is a very important item, especially when cuts are taken in tough steel which has a tendency to bring the temperature of the cutter up to a point where this welding can

take place. This one item alone is of enough importance to prefer grinding with a cup wheel, provided it can be done without making the slanting scratches.

The next question to be answered is in regard to grade and grit of the wheel to be used. This question cannot well be answered without looking, at the same time, at one of the other things. If it were merely a question of removing a certain amount of metal, a rather soft wheel with medium grit would be about right. However, such a wheel would not produce a desirable finish and, besides, would lose its size so quickly that it would be very difficult to grind the cutter so that all the teeth would be on the same diameter. As in most other things, a compromise must be reached here. The grit must not be so coarse as to produce deep scratches nor must it be so fine as to require a long time to remove the metal, not only would this be a loss of time, but the cutter would be heated too much and the temper might be drawn at the edge. As to grade, it must neither be so soft as to lose size quickly, nor must it be so hard as to have a tendency to clog, for that again would cause loss of time and heating of the cutter. The best practice is to move the cutter rapidly past the wheel taking a shallow cut, and not to try to remove too much metal at one stroke. This method has more than one advantage.

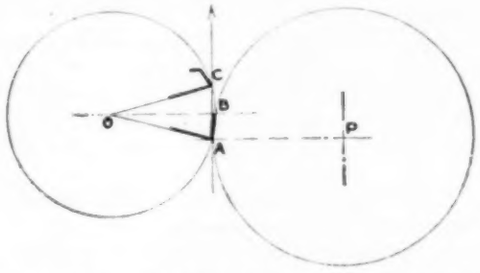


FIG. 183. SMALL CUTTER AND LARGE DISK WHEEL

In the first place, it prevents local excessive heating; in the second place, it prevents gouging, and best of all it keeps all the teeth all the time of even diameter, so that the final cut can be a finishing cut in the true sense of the word.

The tooth to be ground is supported against a tooth-rest, and the direction of rotation of the grinding wheel is such as to force the cutter against the tooth-rest. This makes it easy and convenient for the operator of the grinding machine, but it does not produce the best results so far as the cutter is concerned. Inspection under the magnifying glass will show that a burr is raised at the cutting edge. Furthermore, as the wheel passes the edge to be ground, it carries the heated particles with it. These particles come from the back of the tooth, and are carried toward the cutting edge. The cutting edge is of delicate section and not well adapted to carry off heat.

Fig. 184 shows a tooth in section, the arrow showing in which direction the wheel passes the cutter. The first point struck by the wheel is point No. 1. At this point there is a large cross-section of the tooth to carry off the heat generated. Nevertheless, it must not be forgotten that this section while carrying off the heat becomes hotter itself, and that this heat is conducted in all directions and therefore also to the cutting edge. Besides, the hot particles of metal, the sparks, are compelled to pass this cutting edge heating it still more.

By the time a given point of the wheel reaches point No. 2 the tooth is heated up and the heat generated at point No. 2 must be carried off by a smaller section which is already heated, so that a greater portion of the heat generated at point No. 2 is conducted to the cutting edge. All the time the sparks have been passing this edge, so that it will have reached a high temperature before this edge itself has been touched by the wheel. When finally the wheel acts upon the cutting edge, heat is being generated at a point where there is a very small section to carry off this heat, and where, besides, that section itself is heated to a high temperature. The result is that the edge is softened and this again assists in raising a burr. Examining a cutter after grinding it will often be found that the burr is merely a feather edge, a hair-like strip of metal, pushed off the tooth by the action of the wheel. However, it will be found equally often that the burr is of a much more substantial character, and that it is in reality a rib raised on the inside of the tooth by the pressure of the wheel against the softened metal of the edge.

The shaded section of Fig. 184 represents the amount of heat which must be carried off at the different points of the surface to the ground. As will be seen, the largest amount of heat must be carried off by the smallest cross-section. At *A* is shown the nature of a burr raised when there has been no excessive heating of the edge, while *B* shows what happens when this edge has been overheated.

The very unequal performance of a cutter after various grindings may be attributed to the nature of the cutting edge as it comes off the grinder. The burr at *A* does not do much harm though, of course, it would be better if there were none, but the burr at *B* is very objectionable. The grinder hand, or milling machine hand, on noticing the burr will probably try to remove it by stoning, but this is bad practice as stoning always leaves a rounded edge. Furthermore, though stoning may remove the burr at *B*, it cannot remove the fact that the metal under the burr is soft.

All of the above is merely an argument in favor of reversing the common practice of sharpening cutters. The grinding wheel should enter at the cutting edge, notwithstanding the fact that, in so doing, there is a tendency to push the cutter away from the tooth-rest. The pressure of the wheel against the cutter is not great and the operator can easily counteract this pressure by keeping his hand on the cutter or by hanging a weight from a strap wound around the arbor on which the cutter is mounted. Attention was called to the scratches which the wheel produces on that surface of the cutter tooth which is being ground. Fig. 185 shows a cutter tooth in front view. On a part of that tooth scratches, such as are made when sharpening, are shown in greatly exaggerated proportions. On another part of the same tooth serrations are shown, which are supposed to exist on the underside of the tooth. These serrations are not caused by the grinding wheel, but were made when the teeth were milled in the body of the cutter. These irregularities may have any conceivable shape and are not made any more regular by the subsequent

FIG. 184. ILLUSTRATING THE FORMATION OF A BURR

hardening. Their effect, however, is at least as bad as the scratches in the front of the teeth made by the wheel. It is almost certain that there will be negative clearance somewhere along the length of the tooth, not to any great depth, it is true; but it should be kept in mind that if clearance is required anywhere at all it is right at the cutting edge. For this reason it is to be recommended that the front of the tooth should be ground before the cutter is put to work. As the grinding marks can be made to run parallel to the axis of the cutter, scratches made by the wheel would cause no trouble. Not only should the front of the teeth be ground, but it is recommended that they be ground to a polished finish so as to diminish the friction between the front of the teeth and the chips.

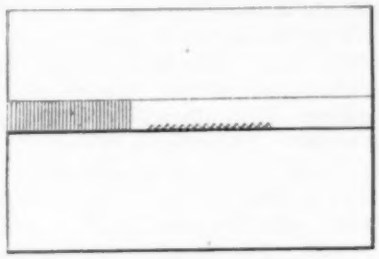


FIG. 185. FRONT VIEW OF CUTTER TOOTH

The Sharpening of Cutters

Instructions for the sharpening of cutters can be found in almost any catalog describing commercial cutter grinders, so that it is not necessary to go into details here concerning the setting up and manipulating of a cutter to be ground. There is one item, however, so important that special attention should be called to it. This is the providing of proper clearance angle to the cutter teeth. It is only in recent years that the importance of this item has begun to be realized, and even now the clearance angle is a matter of guess and chance in a great many shops. Experience has shown that the lasting qualities of the cutter are largely influenced by this angle. Differences in hardness of material and even in the manner of holding the work may affect this angle. Where manufacturing in quantities is done it would pay to carry on a certain amount of experimentation to determine which is the best clearance angle to use. Of course for jobbing work compromise angles are used, such as have been mentioned in the previous articles. As this clearance angle is of such great importance, it stands to reason that proper facilities should be furnished for grinding a cutter to the proper angle.

Formerly there was only one way of setting a cutter for the proper angle. In case a cup wheel was used the tooth to be ground was first set central and then turned downward until it had reached a height of so and so many thousandths of an inch below its original position. Referring to Fig. 176, the point *A* had to be dipped down an amount equal to the radius of the cutter times the sine of the clearance angle, so that, in order to get the correct setting it was necessary to measure the cutter and carry out some calculation. As a rule this was not done. When a disk wheel was used, see Fig. 178, the tooth of the cutter was again set central and then the disk wheel was raised an amount equal to the radius of the wheel—*not the cutter*—times the sine of the clearance angle. There was again the necessity of measuring and calculating. Besides, the man who sharpened cutters only occasionally was very apt to make a mistake and use the radius of the wheel when he should have used the radius of the cutter or vice versa.

The writer's patent, embodied in the cutter grinder made by the Cincinnati Milling Machine Co., provides direct means for setting the clearance angle independent of the diameter of the cutter or wheel, and without requiring any calculation. If the cutter is mounted on an arbor which can be held in the taper socket of the grinder head spindle, or if an end mill with taper shank is to be ground, a tooth of the mill is set central and, in case a disk wheel is used, the center of the cutter is brought to a level with the center of the wheel. This last operation is not necessary when a cup wheel is used. The graduated collar of the grinder head is set to zero and fixed in that position by a set-screw. The spindle of the grinder head is now turned through the desired number of degrees, and this furnishes the proper clearance angle. In case a disk wheel is used the cutter tooth is once more brought to a level with the center of the wheel.

Where a cutter is held on an arbor which must be placed between centers, a special dog is provided which temporarily secures the arbor to the spindle of the grinder head after which the same method is followed. We cannot very well speak of setting the tooth of a spiral mill to the same level as the center of the grinding wheel. We can only place one single point of a tooth in this position and we select a point immediately opposite the grinding wheel. We also take care that we set the center of the tooth-rest under that point.

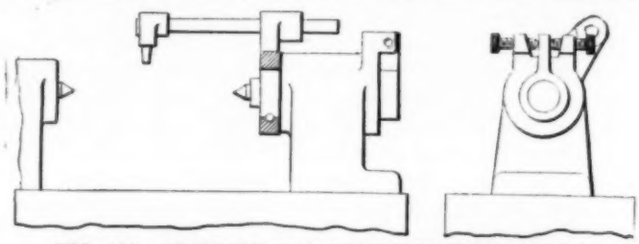


FIG. 186. FIXTURE FOR GRINDING FORM-MILLS

The matter of grinding various kinds of cutters, such as end mills, face mills, spiral mills, etc., involves no difficulties, though it requires some skill and attention on the part of the operator. There are now many cutter grinders on the market which provide all the necessary adjustments for the grinding of practically all standard cutters. When it comes to the grinding of form-mills, hobs and helical cutters, we are confronted with a somewhat more difficult problem.

We have seen, in the article dealing with form-mills, that it is essential to grind the cutter in the same way in which it was made; that is, if the teeth were made radial, we must grind radially and if the teeth were made off-set so as to be tangent to a circle ½-in. in diameter, we must grind the teeth so that after grinding they shall be again tangent to that same circle.

Grinding a plain or spiral mill we feed the wheel into the work by means of the cross adjustment and keep on doing so until the wheel takes a cut on every tooth. We cannot do this with form-mills, for if we did, a radial tooth would no longer be radial after grinding. In the article dealing with form-mills it was pointed out how desirable it is to have the back of the teeth ground when the cutter is new, so that we can put the tooth rest against the back of the tooth. If we do so, and make the tooth-rest a part of a swinging frame which will push the cutter forward around its axis, we will have all the requirements for proper grinding of

form-mills. Fig. 186 shows this arrangement in diagrammatic form.

If a large amount of metal must be ground off the teeth of a form-mill, there will be so much wear of the wheel that at the end of the grinding operation we would have the teeth of the cutter as many thousandths of an inch forward of their proper position as the wheel had worn. In order to overcome this difficulty, we should grind the cutter all around and then take a final cut, and before taking this final cut we should again make sure that the wheel is either radial or tangent to the given circle. This last adjustment should be made with the crossfeed. See Fig. 187.

Form-Mills and Hobs

The same considerations which apply to form-mills apply equally to hobs. There is one point of difference, however, which should be kept in mind. Fig. 187 shows a dished wheel of which the flat side is used for grinding a form-mill. Such a wheel can also be used and in the same manner if the gashes of the hob are parallel with the axis, but if the gashes are spiral, then a dished wheel used in this manner would interfere. In order to grind such hobs the bevel side of the dished wheel to be used should be trued up so as to make a portion of the bevel side with a straight section or contour. The hob should be set in such a relation to the wheel that this straight portion of the wheel points toward the center of the hob. As a rule the spiral of the gashes is of long lead and almost any size of dished wheel can be used without the danger of interference, but occasionally one will meet a hob with a short lead spiral and then it becomes necessary to select a wheel of sufficiently small diameter to prevent such interference.

The backs of the teeth of parallel gashed hobs can be ground for the same purpose for which the backs of form-mills are ground. It would be equally possible to grind the backs of the teeth of spiral gashed hobs, but this would serve no purpose as it is not practical to use the backs of the teeth of such a hob for a guide. In order to grind such hobs with positive assurance that all teeth will be ground to the same diameter, we will either have to indicate the hob after grinding or else do the following: Make a solid former with the same lead as the lead of the hob; grind the backs of one set of teeth of the hob in the same manner as the backs of form cutters are ground; mount the hob and the former on the same arbor; grind the front of the teeth of the former in relation to the ground backs of the hob teeth; use this former every time this particular hob must be ground, taking care to mount it in the same relation to the hob as when it was ground. It will readily be seen that, for the highest accuracy obtainable, each hob must have its own former.

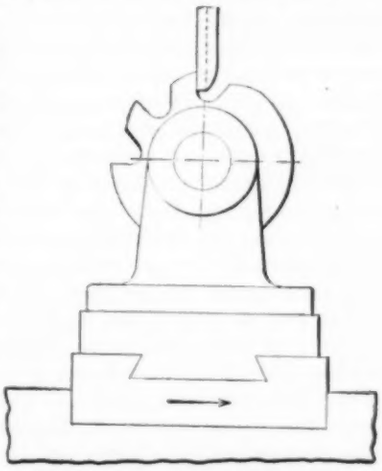


FIG. 187. ILLUSTRATING FINAL ADJUSTMENT OF CUTTER FOR FINISH GRINDING

This is not so much of a drawback as might appear at first glance. The irregularities which exist in the teeth of a hob will not exceed a few thousandths of an inch. So long as we can use the hob we can also use its former, and when finally the hob is worn out and we must start a new one, we can easily regrind the former so as to make it correspond to the new hob.

Grinding hobs with spiral gashes and using a former for guide introduces a slight error. The former rests against an ordinary tooth-rest, whereas the shape of the grinding wheel is a cone. The size as well as the angle of the cone is variable and indefinite. In order

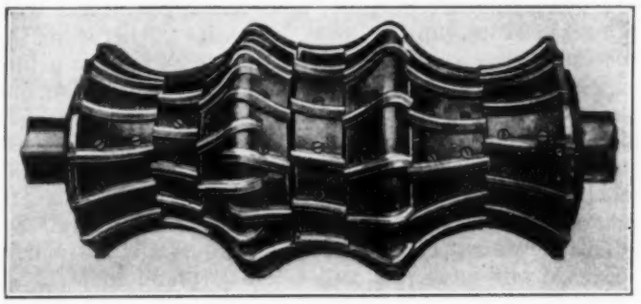


FIG. 188. LARGE COMPOUND FORMED CUTTER

to get a perfect job, the tooth-rest would have to be of the same shape as the grinding wheel. However, in practically all cases the cone of the grinding wheel is of such large size, relatively speaking, that for all practical purposes the element of the grinding wheel in touch with the hob is comparable to the element of the tooth-rest in contact with the former. Though the error will be very slight, yet it is well to remember that this arrangement does not make a theoretically correct job.

Mention was made of form-mills which are not backed off, and of which the contour must be ground. There are several machines in existence at the present time arranged for grinding these contours. The principle of this system of grinding is the copying of the contour of a former or templet, either by a pantographic movement provided by the arrangement of the machine itself, or by mounting the cutter to be ground on a jig or fixture which also holds the templet, and then moving this fixture with its templet past a fixed pin in the machine. When the templet passes the pin the cutter passes a grinding wheel which sharpens the cutter teeth, maintaining the original form.

If the tooth to be ground is on the same level with the axis of the grinding wheel and if the edge of the grinding wheel has the same section as the pin against which the templet slides, the contour generated by the wheel will be an exact duplicate of the contour of the former. However, in doing so, we would get a cutter without any clearance. To provide this clearance we must either lower the cutter or raise the wheel; so that the horizontal plane going through the center of the cutter will no longer go through the center of the wheel. If the normal section of the rim of the wheel is a half circle, then the intersection of this horizontal plane with the wheel will be half an ellipse. It is this half ellipse which would act on the cutter. As the pin along which the former slides is of circular section and the acting part of the wheel has an elliptical section, the outline generated by the wheel would no longer correspond to the outline of the templet. In order to overcome this difficulty it is necessary to give the wheel such a shape

that it will have a semi-circular section at the point where it acts on the cutter, and this is provided for in such machines by having a trueing device which always acts at the height of the center of the cutter and gives to the wheel at that height a section corresponding to that of the pin.

It will readily be seen that this mode of grinding offers considerable difficulties. Where, for instance, a form-mill has part of its outline parallel to the axis and joins another part at right angles to the axis, a wheel must be used at this particular point with a sharp corner; for other junctions between different lines a wheel may be needed with a very small radius, where as for still other portions a more rugged wheel with larger radius can be used. It might, therefore, be necessary to change wheels several times for the grinding of one cutter; and, furthermore, when doing so, one is confronted with the difficulty of making a perfect joint on the cutter where the action of one wheel has stopped and another one begins. On the other hand, such a mode of producing the proper contour may be useful for very large cutters, as illustrated in Fig. 188.

As a rule cutters are used until they are too dull to be used any more. It will often be found that one or more teeth are badly damaged because they have been used beyond the point where they were in proper shape for cutting. In such a case it may be necessary to remove a large amount of metal by grinding. Not only does this require a great deal of time for grinding but the cutter is soon used up under such conditions. Cutters are expensive tools and every effort should be made to make them last as long as possible. It has been found that the destruction of a cutter tooth takes place during a very short period of time. A cutter may have been used six hours and be in practically perfect shape, and yet after 6 hr. and 5 min. it may be so dull that it is necessary to remove $\frac{1}{16}$-in. per tooth. For this reason it is recommended to regrind the cutter while it is still sharp.

Where pieces are manufactured in large quantities, it would pay to do some little experimenting in order to find out how many pieces can be milled with one grinding of the cutter, and then to make it a rule to regrind the cutter before this point is reached. If it is found, for instance, that the cutter will last 7 hr., it would be good policy to establish the rule that the cutter must be taken out of the machine and reground every five hours. Not only does this method save the cutter, but it also makes the workman feel safe in the use of higher speeds or feeds, or both. He is naturally inclined to cut down feed or speed when he finds that his cutter is badly damaged or dull after a certain length of time. If, however, he finds his cutter is still in good shape at the end of the specified period, he will not hesitate to use the highest practical feed or speed.

Data on Depths of Cuts on Big Work

By William K. Stamets

The writer, who handles machinery in the Pittsburgh district, recently sent out a questionnaire to a number of representative concerns, in which the master mechanic or shop superintendent was asked to give his best opinion as to what is considered good practice as to the size of cuts which might be carried on a 36-in. and on a 60-in. triple-geared standard engine lathe. These sizes of lathes were chosen as fairly representative and as covering a considerable range. It was suggested that the work be assumed to be forgings of 0.50 carbon steel 18 or 20 in. in diameter. The information contained in the replies received was tabulated and is shown in the accompanying table.

SIZE OF CUTS WHICH MAY BE CARRIED ON 36 AND 60-IN. STANDARD ENGINE LATHES (TRIPLE GEARED) ON 18 TO 20 IN. DIAMETER FORGINGS OF 0.50 CARBON STEEL

	36-In.				60-In.			
No.	Depth Cut In.	Feed In.	Cutting Speed Ft.	Pounds per Hr.	Depth Cut In.	Feed In.	Cutting Speed Ft.	Pounds per Hr.
1	$\frac{1}{4}$	$\frac{1}{16}$	.....	.....	$\frac{1}{4}$	$\frac{1}{16}$	.....	.....
2	$\frac{1}{4}$	$\frac{1}{16}$	25	590 lb.	$\frac{1}{4}$	$\frac{1}{16}$	25	885
3	$\frac{1}{4}$	$\frac{1}{16}$	20	270 lb.	.....	.....	.....	.....
6	1	$\frac{1}{16}$	35	705	$1\frac{1}{2}$	$\frac{1}{16}$	35	710
8	$\frac{1}{2}$–2	$\frac{1}{4}$	40	1,080 to 1,620	$1\frac{1}{2}$	$\frac{1}{4}$	40	2,700
14	$\frac{1}{4}$	$\frac{1}{16}$	.....	.....	.....	.....	.....	.....
16	$\frac{1}{2}$–1	$\frac{1}{4}$	40–50	810 to 1,350	$\frac{1}{2}$–1	$\frac{1}{4}$–$\frac{5}{16}$	40–50	810 to 1,350
17	$\frac{1}{2}$	$\frac{1}{4}$	25–30	420 to 504	1	$\frac{1}{4}$	30–40	810 to 1,080
20	1	$\frac{1}{16}$	.....	.....	.....	.....	.....	.....
21	$\frac{1}{2}$–1	.....	.....	.....	1–1½	$\frac{1}{4}$	.....	.....
25	$\frac{1}{4}$	$\frac{1}{16}$	20	405	1–1½	$\frac{1}{4}$	20	540–607
28	$\frac{1}{4}$	$\frac{1}{16}$	60	1,418	$1\frac{1}{2}$	$\frac{5}{16}$	50	2,110
29	1	$\frac{1}{16}$	35	1,390	$1\frac{1}{2}$	$\frac{1}{16}$	35	2,085
31	1	$\frac{1}{16}$	20	540	1	$\frac{1}{4}$	20	1,080
32	$\frac{1}{4}$	$\frac{1}{16}$	16	336	$\frac{1}{2}$–1	$\frac{1}{16}$	12	360–420
34	$\frac{1}{4}$	$\frac{1}{16}$	.....	.....	1	$\frac{1}{4}$	.....	.....
37	$\frac{1}{2}$–2	$\frac{1}{16}$ to $\frac{1}{4}$	30–40	300 to 810	1–1½	$\frac{1}{16}$ to $\frac{1}{4}$	30–40	1,215 to 2,700
39	$\frac{1}{4}$	$\frac{1}{16}$	.....	.....	1	$\frac{1}{4}$	.....	.....
41	$\frac{1}{2}$–1	$\frac{1}{16}$ to $\frac{1}{4}$	.....	.....	$\frac{1}{2}$–1	$\frac{1}{16}$ to $\frac{1}{4}$	.....	.....
43	$\frac{1}{2}$	$\frac{1}{4}$	30–35	1,215 to 1,417	$\frac{1}{2}$	$\frac{1}{4}$	30–35	1,215 to 1,417
44	1	$\frac{1}{16}$	.....	.....	1½	$\frac{1}{16}$	.....	.....
45	$\frac{1}{4}$	$\frac{1}{16}$	.....	.....	1½	$\frac{1}{16}$	.....	.....
46	$\frac{1}{4}$	$\frac{1}{4}$	.....	.....	1½	$\frac{1}{4}$	.....	.....
47	.....	.....	.....	.....	.....	$\frac{1}{4}$	35	1,417
48	.....	.....	.....	.....	1½	$\frac{1}{4}$	15	1,518

One of the statements occurring frequently in the replies was that the present day heavy lathes have greater strength than the cutting tool and that the latter either loses its cutting edge or the tool breaks off. The statement was also made that greater trouble is experienced with the apron drive of the carriage than with the headstock drive. It has been the observation of the writer that this is quite generally true of engine lathes when performing heavy work.

Reference to the table will show, in the case of the 36-in. lathe, a depth of cut varying from $\frac{3}{8}$ to $1\frac{1}{2}$ in., feed per revolution varying from $\frac{1}{32}$ to $\frac{1}{4}$ in., cutting speed per minute varying from 16 to 60 ft., and rate of removal of material per hour varying from 270 to 1,620 lb. In the case of the 60-in. lathe, the table shows corresponding quantities as follows: depth of cut, $\frac{3}{4}$ to $1\frac{7}{8}$ in.; feed per revolution, $\frac{1}{4}$ to $\frac{5}{16}$ in.; cutting speed per minute, 12 to 50 ft.; material removed per hour, 360 to 2,700 pounds.

One manufacturer advises that on specially designed hogging lathes he was able to maintain in continuous service a rate of removal of material approximately 1,000 lb. per hour, but that on standard engine lathes such as are regularly sold, his observation led him to believe that for durability it should not be expected to remove material in the case of the 36-in. lathe faster than 450 to 500 lb. per hour, and in the case of the 60-in. lathe, 500 to 600 lb. per hour.

Some of the higher rates of removal of material shown in the table are probably based on the idea of using both front and rear cutting tools, thereby reducing by one-half the cross-section of the cut and greatly reducing the pressure on the point of the cutting tool. Some of the smaller rates of removal of material were doubtless presented by individuals in whose practice there is little occasion for rapid removal of large amounts of material. On long forgings it becomes convenient to employ a second carriage which increases the rate of removal of material in proportion as the additional cutting tools are kept at work.

Heat-Treatment of Thor Tool Parts

Efficient Methods of Heat-Treating Pneumatic Tool Parts—Remarkable Control System to Check Workmen—Up-to-Date Equipment in Shop and Laboratory

By J. V. HUNTER
Western Editor, *American Machinist*

THE heat-treating methods for pneumatic tools require the closest scrutiny in order to produce the quality of materials that are demanded for this class of tools. Pneumatic tools, and particularly

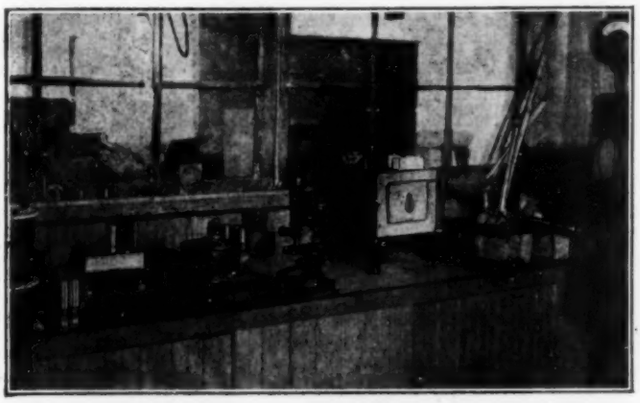


FIG. 1. FURNACE AND TESTING BENCH IN METALLURGICAL LABORATORY

hammers, are subjected to intense and rapidly repeated vibrations and shocks. These tend to produce the so-called crystallization of the microstructure of the steel that usually develops from minute flaws that are the result of improper treatment of the steel either during its manufacture or subsequent heat-treatment. Proper heat-treatment can reduce to a minimum the possibility of trouble occurring from these flaws. In the variety of work and multiplicity of materials to be handled, the tool plant has many problems. The handling of such problems has led to the development of special methods in the Aurora plant of the Independent Pneumatic Tool Co., Chicago, Ill.

There are few parts used in the makeup of this company's various lines of product that are not subject to heat-treatment of one form or another. The material composition of the parts is so different and their uses so diverse that a wide range of treatments is required to handle all of the varying conditions. Each batch of steel that comes in is carefully tested before it goes into process in the shop. It is frequently found that slight changes must be made in the methods of heat-treating apparently almost identical batches of steel of the same grade, in order to obtain the uniform physical properties that are required.

All shipments of special steels are first subject to chemical analysis to determine whether the material meets the specifications. The physical testing in so far as it pertains to heat-treating is handled in a laboratory connected with this department. A small portion of one of the laboratory benches that is shown in Fig. 1 contains two electrically heated furnaces used for treating samples. The furnaces are also used for checking thermocouples against established standards. Some of the electrical instruments used for this checking may be seen near the center of the bench.

The workbench shown in Fig. 2 has been especially arranged for the preparation of test specimens for microscopic inspection. Power for grinding and polishing is furnished by the motor located beneath the bench shown at the left. It drives a short lineshaft fitted with multi-speed friction clutches and tight and loose drive pulleys. The bench grinding stand at the right is fitted for the preliminary treatment of specimens that must be polished for etching. Two grinding wheels of equal diameter that have been cemented together are carried on each end of the arbor. Their grades range from a coarse, fast cutting wheel at the left to a very fine grade at the right, thus giving the operator four grinding steps toward getting his finished surface. Grinding is done on the sides of the wheels, not on the face.

The final polishing is done on the vertical spindle polishing wheels *A* and *B*. The first of these carries a coarse and the latter a fine grade of polishing compound. These polishing plates are steel disks similar to the one shown at *A*, Fig. 3, and have a socket on the under surface that fits over the upper end of the spindle. The top surface is covered with a cloth as

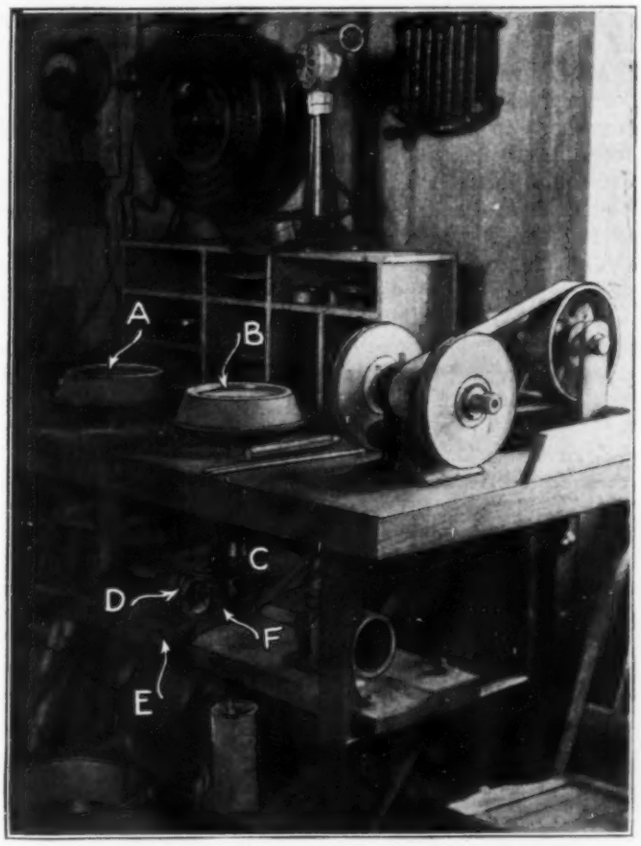


FIG. 2. GRINDING AND POLISHING WHEELS FOR PREPARING SAMPLES

illustrated. For the coarse polishing the grit used is flour emery and for the fine grade, No. 65 C alundum. A third disk can be substituted on either spindle for

finish polishing with rouge. Polishing is done wet, and for this reason the wheels are surrounded by spray guards that catch all the dirt and water and permit

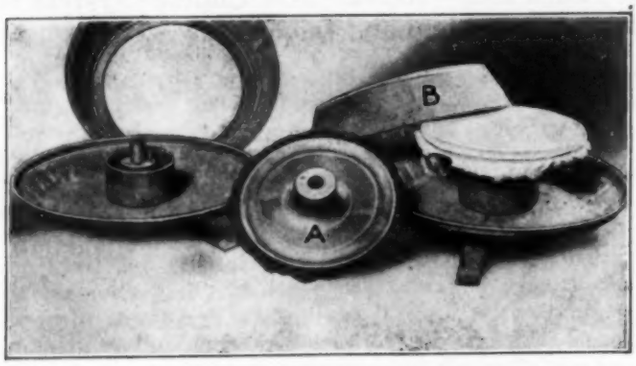


FIG. 3. POLISHING DISKS, SPINDLE HEADS AND GUARDS

it to drip into a receptacle provided for that purpose. One of these guards is shown removed from its place at *B*, Fig. 3.

The friction drive for these wheels can be seen beneath the bench. Each spindle has a steel disk *C*, Fig. 2, which is driven by a steel and fiber wheel *D* mounted on the main shaft. By adjusting the position of the fiber wheel with respect to the center of the vertical spindle a wide range of speeds can be obtained. To stop the grinding disks the lever *E* is raised to a notch on its guard *F* which separates the disk from the wheel *D*.

The electric drier used for drying the specimens after etching may be seen standing on the shelf in the center of the illustration.

Many grades of carbon and alloy steels are used and for each of them the metallurgist designates the heat-treatment to be given. Sometimes the same grade of steel is subjected to different treatments owing to its use for different kinds of service. All treatments have been standardized and are recorded on cards similar to the one shown in Fig. 4.

The treatments are divided into five main divisions and for each of these the same form is printed on a card of different color. The divisions and their designating colors are: Annealing, white card; heat-treating, yellow; carbonizing, blue; hardening, red; and drawing, salmon. There is a wide variety of treatments in each of these divisions and for each of the different treatments a separate card is made out and numbered in sequence. Thus at the present time the number of treatments in each of the groups is: Annealing, 20; heat-treating, 22; carbonizing, 17; hardening, 47; and drawing, 83. For special cases treatment cards are made out in the same manner and given a serial number.

Heat treating.

DATE _____ NO. 2

MATERIAL _____

ANALYSIS		DESCRIPTION OF OPERATION
CARBON		
MANG.		
PHOS.		Heat to 1600-1625 F. and quench in oil.
SUL.		
SIL.		
NICKEL		
CHROME		
VANADIUM		

FORM A-321 1700 12-10-19

FIG. 4. CARD USED FOR RECORDING HEAT TREATMENTS

Several sets of the cards are made up: One for the planning department, another for the metallurgist, a third for the attendant who checks the furnace temperatures. A set is always available to the furnace men and heat-treaters.

The desk and instrument board shown in Fig. 5 are used by the attendant who constantly checks the furnace temperatures. The open card-filing case that appears in the foreground contains the set of treatment operation cards that he also uses.

Each job that comes into the furnace department carries with it a record card that gives the catalog number of the part. From this number the operation performed on that part is determined by the standard records. The furnace man thereupon fills out the card

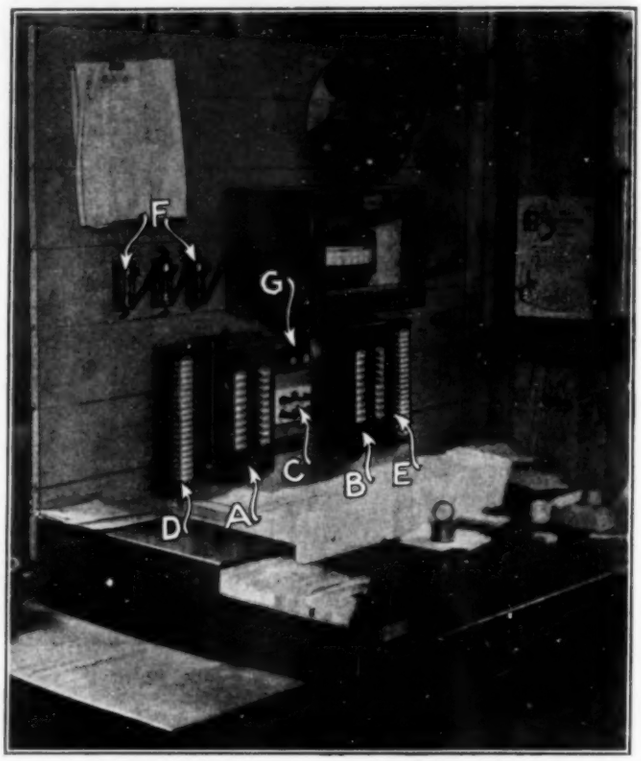


FIG. 5. INSTRUMENT BOARD AND RECORDS TABLE FOR FURNACE CHECKER

shown in Fig. 6 and turns it in to the furnace checker when the job goes into the furnace.

The reverse side of the card is a ruled, printed form as shown in Fig. 7. There are eleven main vertical division lines across the length of the card and each is numbered to correspond with the hour, so that the card covers the period between 7 a.m. and 6 p.m. A main division is divided by light lines into six divisions, each representing a period of ten minutes. The heavy horizontal lines divide the card into nine main divisions each representing 100 deg. of temperature; and these are divided by lighter lines into divisions indicating 20 deg. each.

In a case like the one shown in Fig. 7, the furnace checker determines the probable range of furnace temperatures as indicated by the requirements of the heat and designates the abscissæ accordingly. In this case the range is from 900 to 1,700 degrees.

The checker now proceeds to record the furnace tem-

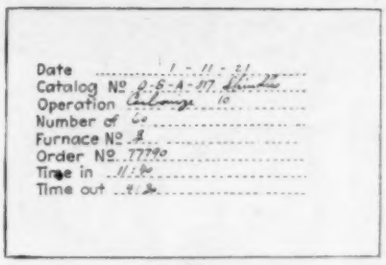


FIG. 6

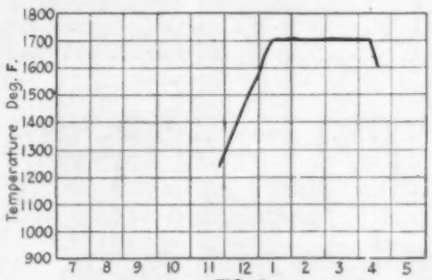


FIG. 7

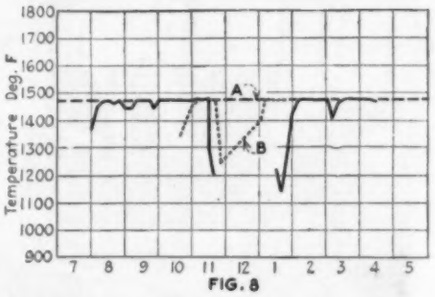


FIG. 8

FIG. 6. JOB CARD FILLED IN BY FURNACE TENDER. FIG. 7. REVERSE SIDE OF CARD, FIG. 6, SHOWING HEAT RECORD. FIG. 8. TEMPERATURE CHART FOR THREE HEATS RUN ON SAME JOB

perature as this lot of work passes through its treatment. The temperature is read at frequent intervals and plotted on the chart by pencil-point dots. A continuous line is drawn later, connecting these dots, and shows the rise of the furnace temperature to the proper point and indicates the time when the charge was drawn.

Jobs are frequently so large that they can neither be finished in one heat nor in a single furnace. An example of the way a job of this character is handled is shown in its chart, Fig. 8. This operation called for hardening from a temperature of 1,465 deg., so for convenience the checker drew a red pencil mark clear across the card at this temperature. (Represented in illustration by long dashes, *A*.) The other side of the card indicated that the operator would use two furnaces—No. 8, marked in black pencil and No. 7 in blue pencil. The checker has made his chart accordingly, showing the curve for No. 7 furnace in a blue line (dotted line *B* in illustration). The pencil-point marks show the respective checking of the three heats.

Electrical arrangements have been provided by which the furnace checker is able to keep close tab on the thirty-five or more furnaces in the shop. He can instantly signal to each furnace operator if the check shows that the furnace temperature has varied from its proper standard.

The indicating pyrometer in the case over the table can be connected in circuit with any one of forty thermocouples by means of the switches on the boxes *A* and *B*, Fig. 5. Either of these switch boxes is in turn thrown into the circuit by throwing the blades of the double-throw knife switch *C* either to the right or left.

The checker constantly passes through his pile of cards representing each furnace in service, reads the temperatures and plots that point on the curve. The minute that the check shows a furnace off temperature he signals the operator to that effect. This is accomplished by pushing the proper annunciator button on either switchbox *D* or *E*. At the same time one of the switches at *F* is closed. The switch at the left lights a blue light that indicates the temperature is too low; the right-hand switch lights a red light and indicates too high a heat. The center switch shows a white light and is only used to indicate the end of a run.

Mounted on posts in the furnace room, where they can easily be seen by the furnace men, are two signaling devices similar to the one shown in Fig. 9. When the checker in the office presses the annunciator button to indicate a furnace off temperature, the bell *A* rings and a hand on the indicator shows the number of the furnace that has been checked. The three colored signal lights are mounted above the indicator and a glance at these shows what trouble is indicated.

On the opposite side of the post is mounted a case, Fig. 10, containing a pyrometer and switchbox for 20 thermocouples. This is always available to the furnace operators for checking their heats.

When the furnace checker signals a furnace a little white disk on one of the two signaling devices at *G*, Fig. 4, throws over to the left. When the furnace man perceives the signal, he acknowledges it by pressing a button in the electrical circuit and the disk is returned to the right.

A glimpse of a few of the furnaces and quenching tanks is given in Fig. 11. The furnaces cover a wide assortment of types and sizes, thus affording a variety from which may be selected the one best adapted for any given job. Most of these furnaces are at present gas-fired, using standard city gas as a fuel. However, a gradual change is being made and fuel oil burners are being adapted to some of the furnaces. Eventually oil will probably form the major portion of the fuel used. They have found oil to be a far cheaper fuel and with the improved burners lately installed the ease of control of the furnace temperature seems to be in no way affected.

The waste oils from the factory processes comprise a portion of the fuel used. These wastes include oil and naphtha from the various parts-washing tanks. There is considerable naphtha and it aids the combustion of the fuel.

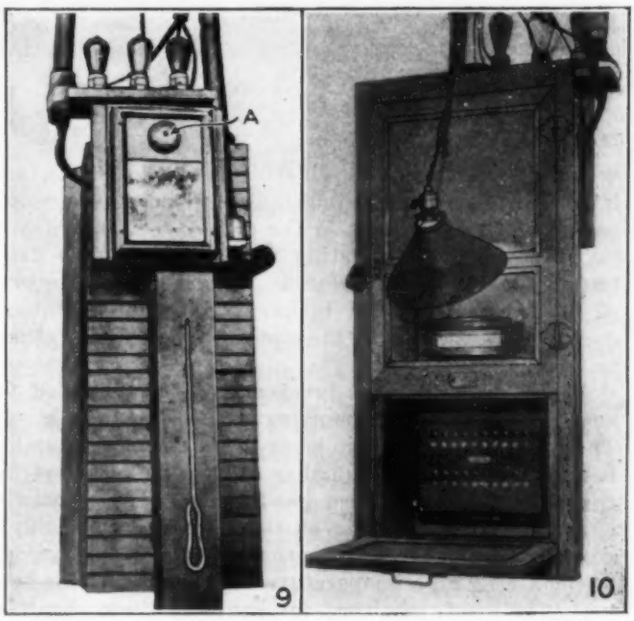
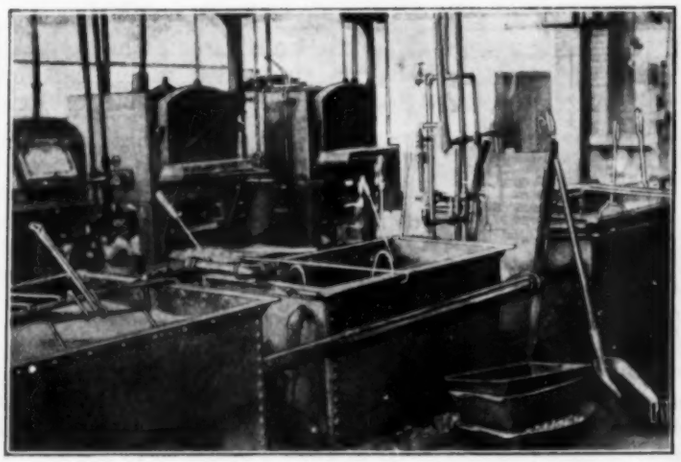


FIG. 9. ANNUNCIATOR AND INDICATING LIGHTS FOR FURNACE CONTROL. FIG. 10. PYROMETER CASE AND MULTIPLE CONTROL SWITCHBOARD



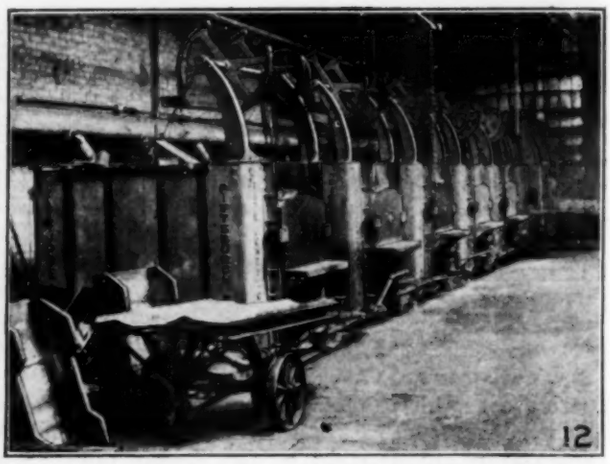


FIG. 11. A FEW HARDENING FURNACES AND QUENCHING TANKS. FIG. 12. BATTERY OF FURNACES FOR HEAT-TREATING AND CARBONIZING

A number of quenching tanks show in the foreground, and comprise a single row of tanks, faced on both sides by rows of furnaces. Tanks are provided with varied quenching mediums to meet all conditions, and these include clear water, brine solutions and quenching oils.

Only soft water is used in the water-quenching tanks. This is collected from the roofs of the shops and is

FIG. 13. DEPARTMENT FOR PACKING CARBONIZING POTS

stored in a large cistern, located near the buildings. Water is constantly pumped from the cistern and circulated through the quenching tanks, replacing the heated water which flows back to the cistern. A coil of pipe carries this cold circulating water through the brine tank for cooling that solution. The heated quenching oil is drawn from the tanks and circulated through cooling coils located in the cistern, and thence returns to the tanks.

A row of Tate-Jones furnaces recently installed for heat-treating and carbonizing is shown in Fig. 12. These replaced a row of home-made furnaces that had been in service for a number of years. The first five furnaces in the row are gas-fired and the remainder burn oil. The majority of the furnaces have only a single burner but three are provided with double burners for obtaining high temperatures and equalizing the heat.

One of the trucks used for handling the carbonizing pots is shown in the foreground. The platform of the truck stands level with the floor of the furnaces so that loaded carbonizing pots are easily slid from one to the other.

The carbonizing pots are packed and unloaded in a room separate from the furnace room and shown in Fig. 13. This separation has a number of advantages: It keeps the carbonizing supplies from littering the furnace room; the dust and dirt is shut off by itself, and lastly, trucks loaded with heated pots can be pulled out here to cool without adding to the discomfort of the furnace tenders.

The casehardening pots most commonly used are cylindrical in form and are made in the shop from sections of steel pipe in which disks are acetylene-welded to form bottoms. They are 4, 5 and 6 in. in diameter and are 11 in. high. Rectangular pots are also used for certain classes of work, and these are usually 6-in. or 11-in. cubes. The stock of spare pots is carried on a steel rack that has been constructed along the wall shown at the right of the illustration. Bins on the further side of a doorway serve to store the carbonizing materials.

Several makes of prepared carbonizing compounds are in use, the dominant considerations in selecting them having been the power of penetration and life. The life is determined by the rapidity with which the compound turns to dust, as it is then worthless. To prevent unnecessary burning of the compound after loading, all pots are carefully covered with fireclay.

The tall sheet-metal case shown at the rear of the room, partially covering the window, is an apparatus now under construction for recovery of the carbonizing material. The greatest loss of this material occurs as it gradually is mixed with dust from the fireclay luting

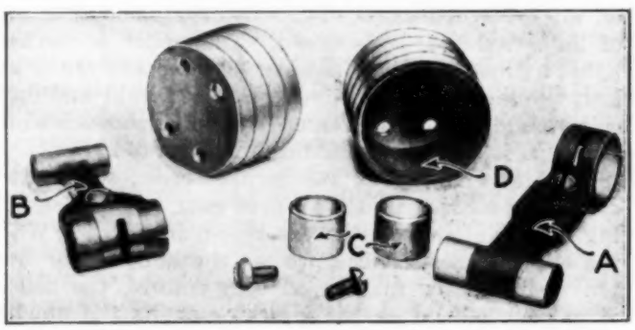


FIG. 14. PARTS COPPER-PLATED FOR SELECTIVE CARBONIZING

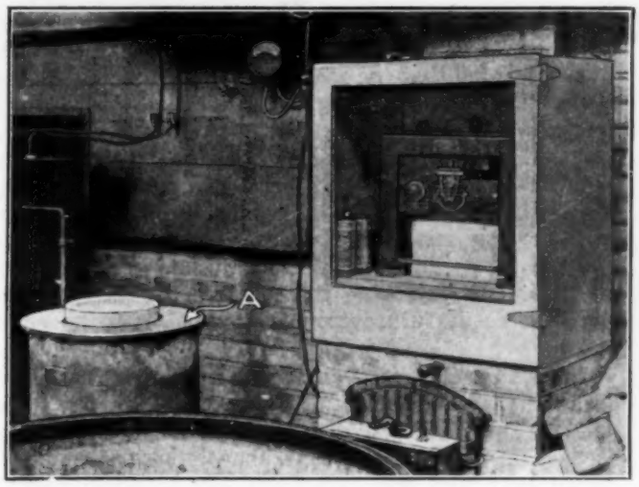


FIG. 15. ELECTRIC FURNACE USED FOR HARDENING DIFFICULT WORK

and from burned-out carbonizing material. To continue the use of such material would result in spotted carbonizing and it must be rejected although its major portion is still suitable for producing a good "case."

Upon the completion of this apparatus all case-hardening material will be dumped from the pots into a bin at the base and carried from there by a light chain-bucket conveyor to a hopper at the top. From the hopper the material will slowly fall over a series of sloping screens inside the casing. The screens will be graduated in size so that all material classed as waste will be separated. At the same time an upward blast of air will be drawn through the casing by a suction fan, and this air blast is expected to carry away with it the major portion of the fine dust and waste. When the material reaches the bottom it will fall into a bin from which it will be elevated to a storage bin.

The success of carbonizing on certain classes of pneumatic tool parts depends upon sectional coating that will give a "case" where wear occurs and leave other sections soft. Examples of work that have been so treated are shown in Fig. 14. Two methods are employed for applying a protective coating to the portions that are not to be carbonized. One of these is an enamel that can be painted over portions of steel parts, but this is not so convenient as is copper-plating. The parts shown have been copper-plated over those surfaces that appear shaded, leaving the bright surfaces clean and ready to take a "case."

The piece *A* is a connecting rod for an air motor, and *B* is another of a different type. The bushings *C* are copper-plated outside and clean inside. The pistons *D* for air motors are drawn steel cups that are hardened only on the outside. These were once plated all over and then turned off on the outside to remove the plating. It was found that the removal of stock and heating during the treatment relieved internal strains and caused distortion that was blamed on the carbonizing department. Now they are annealed first and then turned, and the outside surface is covered while in the plating bath to prevent coating. Since this reversal of operations no distortion occurs.

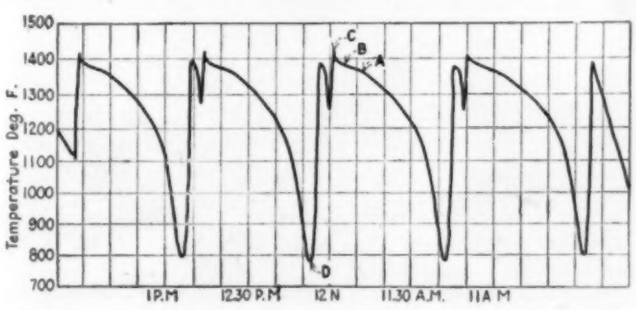


FIG. 16. TEMPERATURE CHART FROM THE ELECTRIC FURNACE

A Leeds and Northrup electric hardening furnace controlled by an automatic recorder has been lately installed and is shown in Fig. 15. The furnace *A* is operated by the "hump" method for determining the critical temperature for hardening steel, and is used on particular work, such as spring clips, rivet set clips, exhaust deflectors, connecting-rod clamps and ball races and cones. The "hump" method of hardening depends upon determining the critical point at which the steel should be quenched by watching the rate of absorption of heat by the work. At the critical point the temperature momentarily stops rising. During this period the material stores up an amount of latent heat.

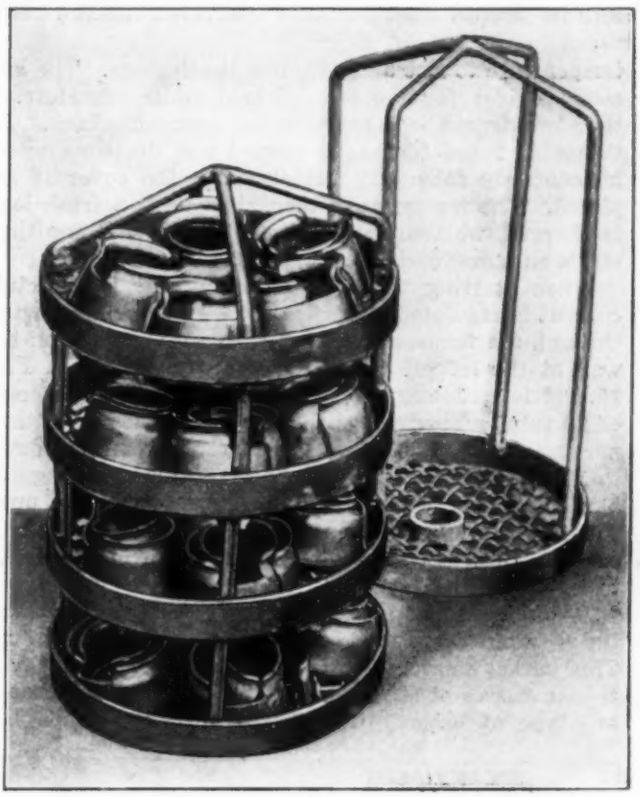


FIG. 17. BASKET WITH FOUR TRAYS FOR HANDLING WORK

The determination of the critical point is strikingly illustrated by the continuous chart recorded by the pyrometer as shown in Fig. 16. This line reads across the sheet from right to left, and the divisions were marked for time and temperature after the removal of the sheet from the instrument.

It will be noted that the temperature curve rises at a fairly even rate until the point *A* is reached. At this point it flattens out and there is a large absorption of heat with little increase in temperature until the point *B* is reached. From the latter point the temperature curve rises very rapidly. This indicates to the furnace attendant that the charge should be drawn and quenched; however, he usually permits the

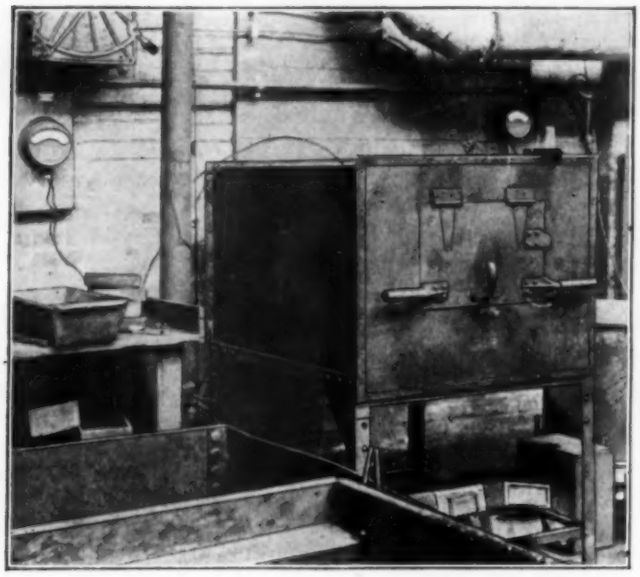


FIG. 18. EATON ELECTRICALLY-HEATED FURNACE USED FOR TEMPERING

temperature to rise an additional ten degrees. The last rise provides for the loss of heat while transferring the work from the furnace to the quenching tank. At the point *C* the furnace is opened and its temperature momentarily falls very rapidly until the cover is replaced. The temperature then rises until a fresh load is charged, whereupon it falls to the point *D* and then starts on a new cycle.

When starting the furnace on a heat the electric current is regulated by a rheostat. The current flowing through the furnace is indicated by an ammeter on the wall at the left of the pyrometer case shown in Fig. 15. It is customary to start the heat with a current of 20 amp., which brings the furnace up nearly to temperature in 25 to 30 min. The current is then cut down to 10 to 15 amp. and this rate is continued during the hardening operations. The ampere rate depends upon the character of work in the furnace and the length of time that has been established for bringing it up to its hardening temperature.

A special basket with four trays used for handling the work in the electric furnace is shown in Fig. 17. This basket was devised in the shop for handling particular classes of shop work. It differs from the standard type of basket, used on this furnace, which has only a single tray as exemplified by the basket shown in the background of the illustration.

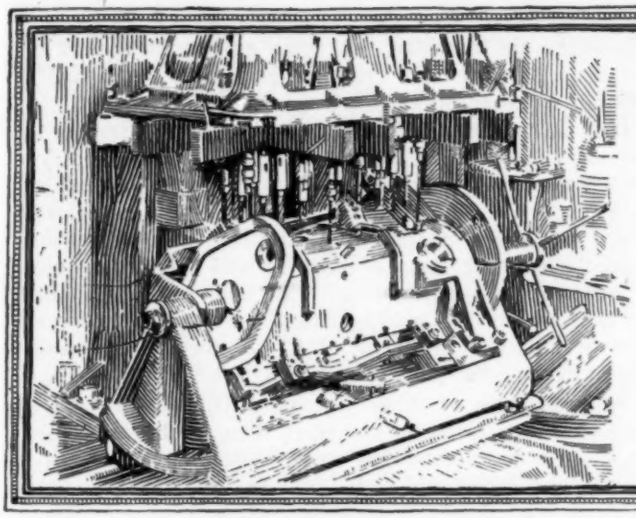
It was noted that the machine finish on many pistons, crankshafts and other small parts had been rough ground before hardening. Other parts were buffed on a rag-wheel to a fairly smooth finish. This was explained to be one of the plant precautions to avoid checks and flaws that might occur in hardening and later develop seriously when the part was in service. These checks usually start from minute cuts like toolmarks and by removing these before hardening a possible source of future trouble is thought to be eliminated.

The Eaton electric oven shown in Fig. 18 has lately been installed and is now used for tempering parts that must be drawn to a high heat. Its temperature range as used in this plant ranges above that obtainable in an oil bath and will run from 400 to 1,000 deg. F. The temperature of the furnace is controlled by a rheostat.

There are certain portions on some of the hardened tool parts that are subject to considerable shock when in service. These portions are tempered by selective drawing methods that have been developed to a high degree of success. This work is done on benches, as shown in Fig. 19, where gas burners are employed in pairs for heating the work. The workman is shown using the gas flames to heat opposite sides of the work until the temper of certain spots has been drawn to the proper color. A pair of the burners *A*, supported by the standards *B*, can be swiveled or tilted to any desired position. The standards have a weighted base and can be moved freely about the bench as far as the length of gas hose permits. A light blast of compressed air is used in the combustion of the gas flame, and the blast can be regulated to spread the flame or draw it to a needle point.

Practically all work submitted to heat-treatments undergoes some degree of distortion. Therefore it is carefully inspected before it leaves this department and assurance is given that it is in proper condition for subsequent machining operations. Crankshafts and similar parts are tested between bench centers as shown in Fig. 20 and an indicating dial reading to thousandths of an inch is used in testing the throws. Constant practice in this operation enables the operators to become surprisingly adept and a crankshaft is very quickly straightened.

FIG. 19. SELECTIVE DRAWING BY HEATING WITH GAS BURNERS. FIG. 20. STRAIGHTENING CRANKSHAFTS AND OTHER PARTS AFTER HEAT-TREATING



Tool Engineering

By
Albert A. Dowd and Frank W. Curtis
President and Chief Engineer
Albert A. Dowd Engineering Co., New York City

Drill Jig Design Continued—Bushing Design and Proportion—Methods of Holding Slip Bushings—Standard Knobs and Thumbscrews—Ejectors

VARIOUS methods of making bushings, of which some are good and some bad are shown in Fig. 62. The bushing shown at *A* is too short and does not give proper alignment for the drill, so that it is likely to cause inaccuracy as indicated at *B*. It is well to make a bushing from two to three times the length of the drill diameter if possible so that it has an appearance similar to that shown at *C*. So doing keeps the drill in good alignment and does not tend to produce angular holes. A bushing should have sufficient stock in contact with the hole into which it is pressed that it will not tend to loosen when in use. The bushing shown at *D* has only about one diameter in contact with the hole into which it is pressed whereas the bushing *C* has over two diameters. It is sometimes possible to use a construction like that shown at *E* where the jig wall is thin, and it is not possible to obtain great depth for the bushing. A screw such as that shown at *F* can be used to hold the bushing in position.

In regard to the relieving of the inside of the bushing, the form shown at *G* is tapered for a part of its length, a construction much better than if counterbored as shown at *H* because in the latter case the drill lip may strike the edge of the counter-bore and cause trouble. Jig bushings are usually rounded to facilitate the entrance of the drill as indicated at *K*. It is advisable to use a large radius in the mouth of the bushing wherever possible. Data relative to the distance between the work and the bushing have been given in a previous article.

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Slip bushings are used in many cases where it is necessary to drill and ream the same hole in the same jig. The first bushing is made to the drill size and the second bushing to the reamer size. When slip-bushings are used provision must be made to prevent the bushing from pulling out of the jig when the drill is being removed. Several varieties of locks or clamps are shown in Fig. 63. There is shown at *A* a very common type which has a pin *B* with a shoulder which locks the bushing in place, a type used in the majority of shops. A bail-bushing is indicated at *C*. There are advantages to this type of bushing for large work in that it is conveniently removed, as the bail acts as a handle and the bushing is locked in position by snapping the bail down over the pin at *D*. Another form of lock for a

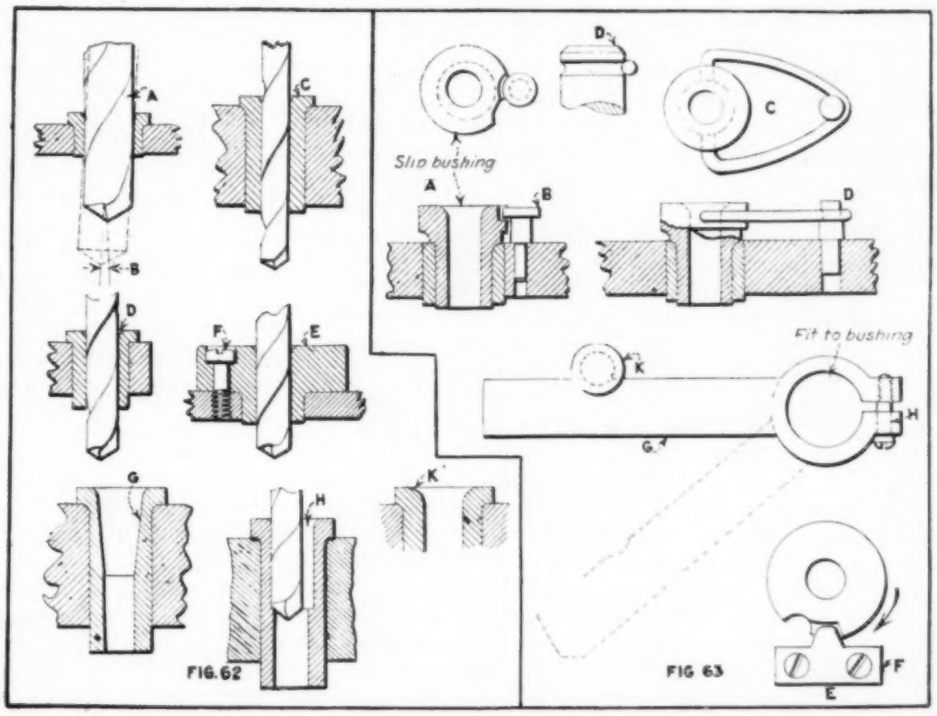


FIG. 62. BUSHING DESIGN AND PROPORTIONS. FIG. 63. METHODS OF HOLDING SLIP-BUSHINGS

slip bushing is shown at *E*, embodying the same principle as that used at *B*. Instead of using a pin for locking, a steel block as shown at *F* is screwed to the jig body. Another form of clamp for holding a slip bushing is shown at *G*. The lever is clamped around the bushing by means of the pinch-binder at *H* and the bushing is prevented from pulling out of the jig by means of the retaining pin *K* which is shouldered so that the lever passes under it. The action of the drill tends to throw the lever against the pin *K*. In removing the bushing the lever takes the position shown by the dotted line.

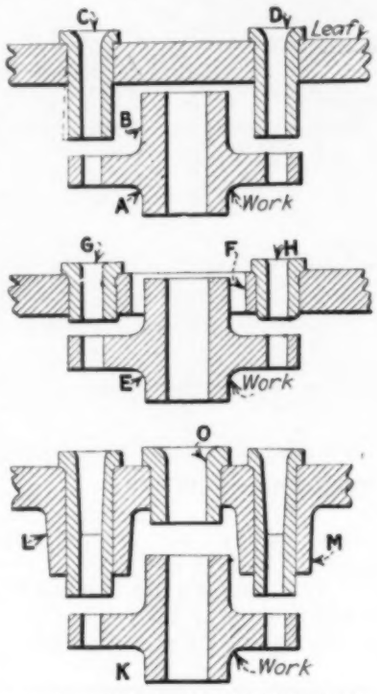


FIG. 64. LOCATING OF BUSHINGS

The shape of the work to be drilled influences to some extent the location of the bushings. There are cases where a piece of work is so designed that it is difficult to place the bushings so that accuracy will be assured in the drilling operation. In the first article of this series the effect of design on the machining process was commented upon to quite an extent, and it was pointed out that the design of the work is an important factor which influences the efficiency of jigs and fixtures. There are some tool designers who are very harsh in their criticism of the pieces for which they are called upon to design tools and are continually suggesting changes in their design. Changes in design are costly, especially if they cause the changing of expensive patterns, and should not be made unless there is something worth while to be gained.

However, it was pointed out that there are numerous instances when a change in design would result very profitably to the manufacturer.

A piece of work is shown at *A*, Fig. 64, having an extended hub *B*. The inexperienced designer would be very apt to locate his bushings as shown at *C* and *D*, without sufficient support in the jig body. Either of two methods can be used to avoid the difficulty. In the method indicated at *E* the jig body is cut out at *F* to allow the hub to pass up into it so that the bushings *G* and *H* can be so made that they will have sufficient contact with the jig body. Another method is indicated at *K*, where the body of the jig is carried down in the form of bosses *L* and *M* to give stock for the bushings. Provision is made for driling the center hole through the bushing *O*.

The ability of the tool designer is frequently shown in small ways such as the application of thumbscrews or knobs to operate various moving parts in the jig. It is well to consider the fact that the workman who handles a jig or fixture has to use his hands all day long. Speaking generally, a knob or thumbscrew should be so arranged that the operator can use it without "skinning his knuckles" on some surrounding part of the jig. The form of the knob should be such that it will not make an operator's fingers sore.

It is advisable to avoid the use of knurled screws as far as possible, because they tend to make an operator's fingers tender if used frequently. The knob shown at *A*, Fig. 65, can be made with as many points as desired and it can be of steel or cast iron. If it is standardized, a number of sizes can be made up and carried in stock to suit various conditions. The hole may be drilled so that it can be readily fitted to standard sizes of screws or studs, as shown at *B*. A pin *C* is generally used to fasten the knob in position.

Another type of knob, shown at D, can be used to advantage in numerous cases. The knob itself may have as many notches as seem desirable, this being a matter for individual decision. In this case the knob is made with a long hub tamped out at *E* so that it can be used to pull up on a stud or down on a clamp; in fact it can be used in a number of ways which will suggest themselves to the tool designer. These knobs also can be made up in several sizes and carried in stock. A very common method of providing a means of adjusting a screw is shown at *F*, where a pin *G* is driven into the end of the screw to act as a handle. In the writers' opinion this construction should be used very seldom, except when very light pressure is to be applied. The objection to this method is that it is hard on an operator's fingers and that he is frequently tempted to use a wrench in order to tighten the screw; as a result the pins very soon become bent and practically useless.

A general form of pin knob is shown at *H* in which the pins are four in number and are set in at an angle. Even in this case however there are objections to the form used for much the same reasons as previously stated.

A very excellent form of knob or thumbscrew is shown at *K*. This form has become a standard in many shops and is excellent both from the viewpoint of economy and convenience of operation. The knob has three points which accommodate themselves to the operator's fingers and do not make them sore. It is a form that

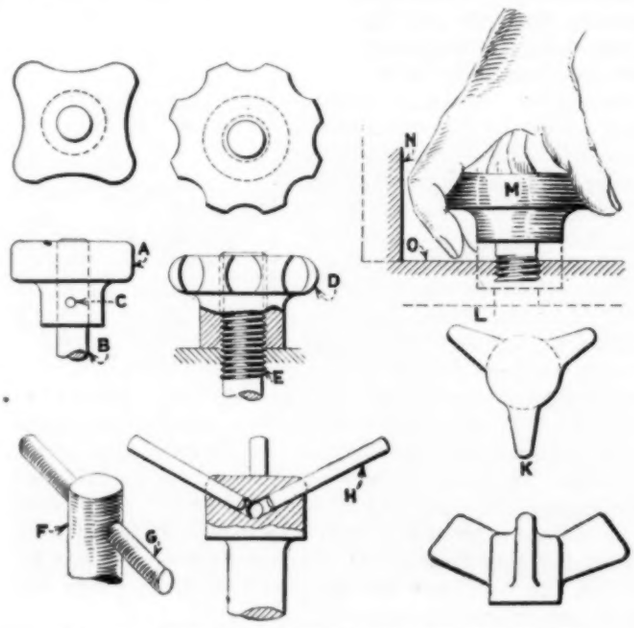


FIG. 65. STANDARD KNOBS AND THUMBSCREWS

can be used as a nut when drilled and tapped, or in a manner similar to that shown at *A*.

A diagram which indicates the importance of clearance for the operator's fingers is shown at *L*. The knob

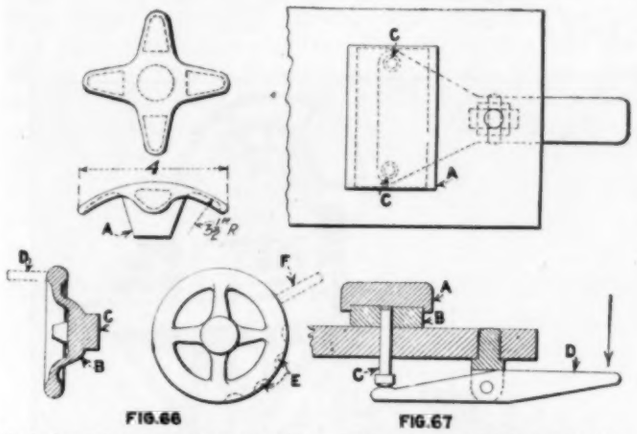


FIG. 66. HANDWHEELS AND LARGE KNOBS

FIG. 67. SIMPLE EJECTOR FOR DRILL JIG

M has been so placed that there is very little clearance for the workman's fingers between the screws and the walls of the jig *N* and *O*. The amount of clearance necessary is shown by the dotted lines. It is a very good idea for a tool designer to imagine that he is operating the jig himself, making sure that his finger clearance is ample. At the same time he must remember that the shop man's hands are somewhat larger than his own and he should therefore make considerable allowance for finger clearance. The writer has frequently seen jigs, considered good by the drafting room, that caused the operator untold trouble, due to improper provision for his fingers.

It should be remembered by the tool designer that the amount of pressure to be exerted influences the size of the knob to be used and it is sometimes found desirable to use a knurled screw in order to prevent the application of pressure enough to distort the work or spring it out of its true position.

On large fixtures it is frequently necessary to use handwheels or large knobs in order to provide pressure sufficient to operate the mechanism. The beginner is very apt to be "stingy" in the details of his design whereas the experienced designer is "generous" and makes a "comfortable" jig which can be used with satisfaction by the operator.

A form of hand knob which has found a great deal of favor with manufacturers in general is shown at *A* in Fig. 66. This form of knob is usually made up in one or two sizes, the example shown being the 4-in. size. A knob of this kind is used only on large fixtures and jigs where considerable pressure is needed. It is generally made of cast iron and the hub is left solid so that it can be drilled or tapped to suit particular conditions. The advantage of this knob is that it fits the palm of the hand and the fingers can go down between the points which enables the operator to get a good grip.

On large fixtures it is often desirable to use handwheels such as that shown at *B*. Handwheels of various sizes can be purchased cheaply and can be drilled or tapped in the hub *C* to suit any particular job. It is also possible to provide the wheel with a handle, as shown by the dotted lines at *D*, if desirable.

There may be cases where it is an advantage to notch a handwheel as shown by the dotted lines at *E* so that an operator can get a little better grip. A handle can be put in as indicated by the dotted lines at *F* to provide more leverage.

There are many cases when it is essential to provide a means for removal of a piece of work from a jig or a fixture. It is not good practice to make up a jig in such form that the operator must use a hammer or screwdriver to get the work out after it has been machined. A simple form of ejector may be used, such as shown in Fig. 67. The work *A* has been placed on the locator *B* which it fits snugly. To remove the work the operator would be obliged to use a screwdriver to pry it off from the locating plug *B* unless provision was made for ejection. It is a very easy matter to insert the pins as shown at *C* and to operate them by means of the lever *D*.

There are many cases where a somewhat simpler form of ejector can be used. The pins *C* could be held by a retainer and the lever *D* left off entirely. The operator could provide a wooden block on his drilling machine table and operate the ejector by striking the pins on it.

There are occasional cases where the removal of a piece of work from the jig requires that considerable

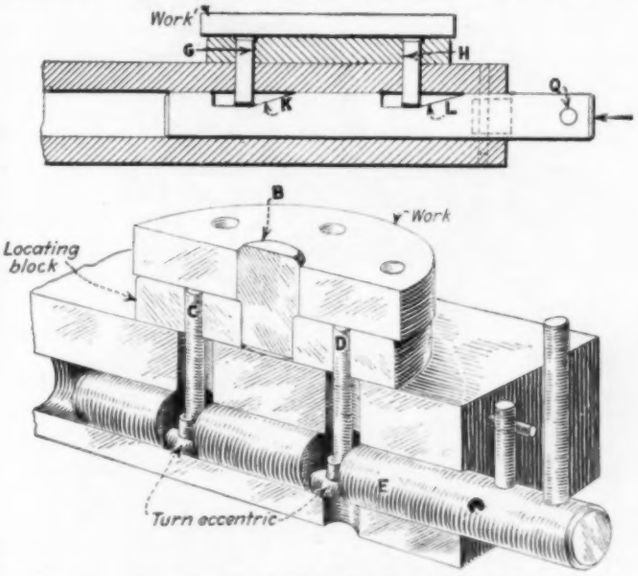


FIG. 68. EJECTORS OPERATED BY ECCENTRIC AND WEDGES

attention be paid to the method of removal. A case of this kind is shown in Fig. 68 in which the work *A* is located on a central stud *B* which it fits closely. Ejectors are formed in this instance by two pins *C* and *D* which extend through the locating block as indicated and rest on eccentric portions of the shaft *E*. When the lever *F* is operated the eccentric cause the pins to rise and push the work from the plug. Another method of operating a similar mechanism is shown in the upper part of the figure. The ejector pins *G* and *H* are operated by means of the angular surfaces *K* and *L* on the rod *P*. A pin or hand knob can be provided at *Q* or as conditions require.

Speaking generally, the use of ejectors would be required on any piece of work that could not be easily removed by hand. It is advisable to consider the conditions and the necessity for ejectors when designing any jigs in which the location is by means of finished surfaces, pins, or plugs. When ejectors are used the pressure must be distributed in such a way that it will not cause a "cramp" or "cock" in the work.

Installation of Motor Drives on Old Tools

Expedients Resorted to in a Railroad Shop to Provide Individual Motor Drive for an Old Planer and a Boring Mill

By J. H. VINCENT

SOMETIME ago the Chicago & Alton R.R. completed its new locomotive shop at Bloomington, Ill., and moved into it machine-tool equipment that had been in the old shop. In connection with the installation, it was desired to install some of the larger machines in the main bay under crane service. The machines are of old types, fitted only for belt drive; it therefore was necessary to build some form of frame or scaffold in which the standard countershafts, together with the new drive motors, could be mounted.

The construction of the steel scaffold used for line-shaft mounting on a large Bement planer is shown

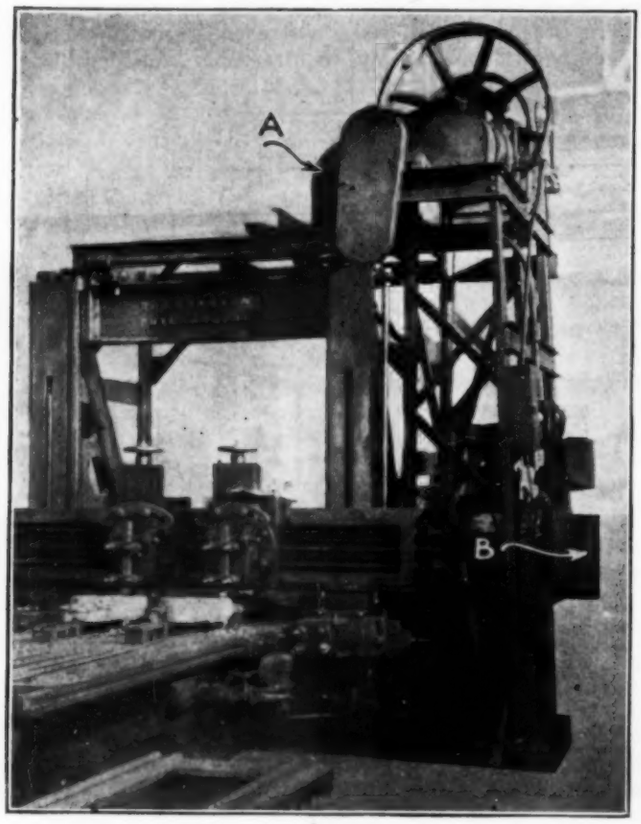


FIG. 1. MOUNTING FOR DRIVE OF LARGE PLANER

in Fig. 1. This planer is usually employed on side and connecting-rod work. The motor is mounted on the top at *A* behind a silent chain-drive housing. Chain drive is used for the first speed reduction on account of the short distance between shaft centers. It is also used for a drive from a stud shaft to the mechanism operating the cross-rail elevating screws. The motor controller box is at *B*, with a safety switch and fuse plugs in the smaller box above.

The scaffold mounting of the countershaft and motor for a smaller planer is shown in Fig. 2. The first speed reduction on this drive is likewise a silent chain that is uncovered as will be seen in the illustration. All belts from the countershaft to the pulleys on the

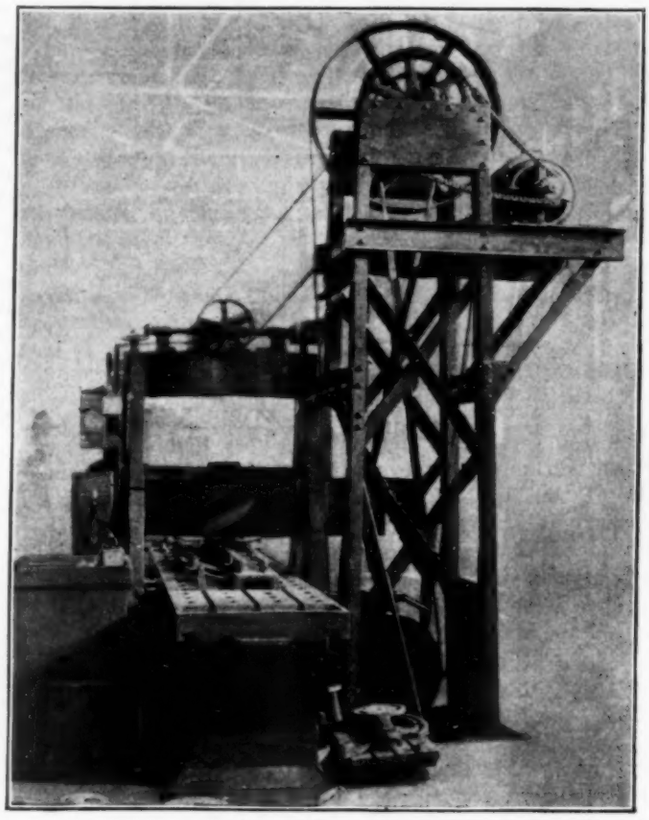


FIG. 2. STEEL FRAME FOR PLANER DRIVE MOTOR AND COUNTERSHAFT

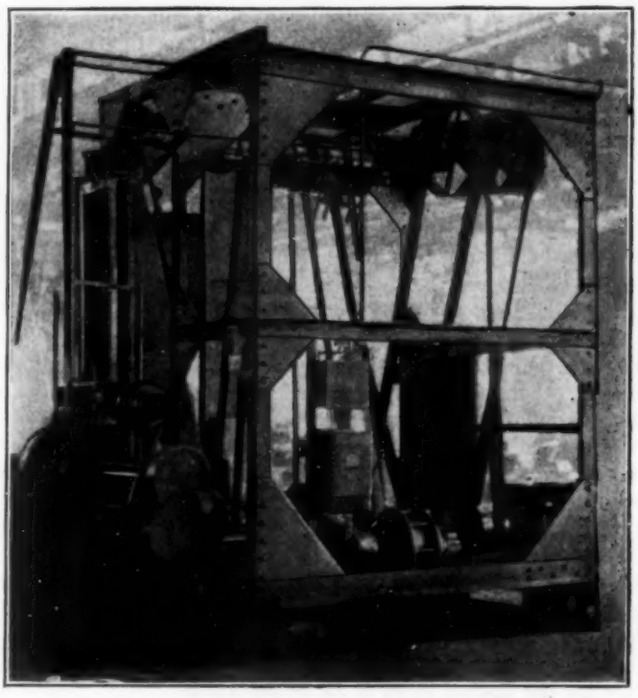


FIG. 3. HEAVY FRAME FOR MOUNTING DRIVE OF HORIZONTAL BORING MILL

planer are inside the scaffold frame, and, thus guarded, insure greater safety for the workmen.

The frame required for mounting the heavy countershaft of a large horizontal boring mill is shown in Fig. 3. Its general type of construction is different from those previously shown. The diagonal bracing has been eliminated and large gusset plates are employed to lend the stiffness required by the frame. The motor is mounted on two I-beams that rest on the floor and its starting box is mounted on cross-bracing located in easy reach of the operator. The unusual mounting for the belt shifting levers and rods shows on the upper left-hand corner of the frame.

Natural Sandstones and Artificial Abrasive Wheels from a Health Hazard Standpoint

BY A. ROUSSEAU
Safety Engineer

[Our recent publication of the gist of a report by Dr. W. Herbert Drury of the U. S. Public Health Service, entitled "Wet Grinding a Dangerous Occupation," has been the cause of considerable comment and we believe that more complete information should be given. Needless to say, the natural inference is that the caption applies to the occupation of wet grinding as a whole, whereas the figures used were obtained from three Connecticut villages in which the manufacture of axes is a major industry, where the operation of wet-grinding, as conducted, *is* a "dangerous occupation." The operation in question is that of grinding axes, hatchets and similar products upon sandstone wheels, the sandstone having certain characteristics that make it desirable for use where production is required without drawing the temper of the work.

What the report does prove is that the use of natural sandstones for axe grinding is extremely dangerous to the health of the operator and that this danger is not eliminated by the use of water. It is perfectly obvious that if natural sandstones were used without water, the operation would be infinitely more unhealthful, if not absolutely prohibitive.

It appears that another thing which was not made clear in our extract from the public Health Report is the fact that the dry grinding referred to was done on artificial abrasive wheels. The difference in structure and grinding action of natural sandstones and artificial grinding wheels is really responsible for the great difference in the amount of dust produced in the two series of tests, in spite of the fact that a stream of water was constantly applied to the natural sandstone and only a dust exhausting system to the artificial grinding wheel.

The following article explains the objects, conditions, and results of the tests.—Editor.]

A recent study has been made by the United States Public Health Service in an axe factory to determine the difference between wet and dry grinding in their effect on the health of workers. The report* on this study is very interesting, as it explains some things which have not heretofore been generally understood.

It has been known for some time that in those plants where the natural sandstones have been replaced by the modern artificial grinding wheels a very noticeable improvement in the working conditions has taken place. The report states that where a suitable exhaust system has been installed in connection with artificial wheels, improvement over the old wet sandstone method has been so great as to put the health risk of the operator in an entirely different class. In fact, according to the report, "the air in such dry grinding shops is comparatively free from industrial hazard."

In making the study referred to, the investigators used scientific apparatus by which it was possible to determine the actual number of dust particles of various sizes in the air at any time. Previous investigations in other industries had shown that only those particles of dust which measure 10 microns and under in diameter need be considered as having any effect on the health. (Note—10 microns equals approximately 0.0004 in.) It had also been determined that where the number of these particles is less than 200,000 per cubic foot the condition of the air would not be considered dangerous.

Ten tests were taken in a room of the axe factory where dry grinding is done on artificial grinding wheels provided with exhaust system. These tests showed an average of 154,500 particles per cubic foot, measuring 10 microns and less in diameter. This indicated that the amount of dust in the air was well below the danger point.

Thirty-two tests were then taken in the wet-grinding shops where the grinding is done on natural sandstones and where water is applied to the wheels for the purpose of preventing dust. In spite of the water, however, the tests show that the conditions were much worse than in the dry-grinding departments. The 32 tests showed an average of 15,800,000 particles per cubic foot, measuring 10 microns in diameter and less. This is over 100 times as many as in the dry-grinding room and means that for every particle of this size which an operator in the dry grinding breathes, an operator in the wet-grinding department breathes more than 100.

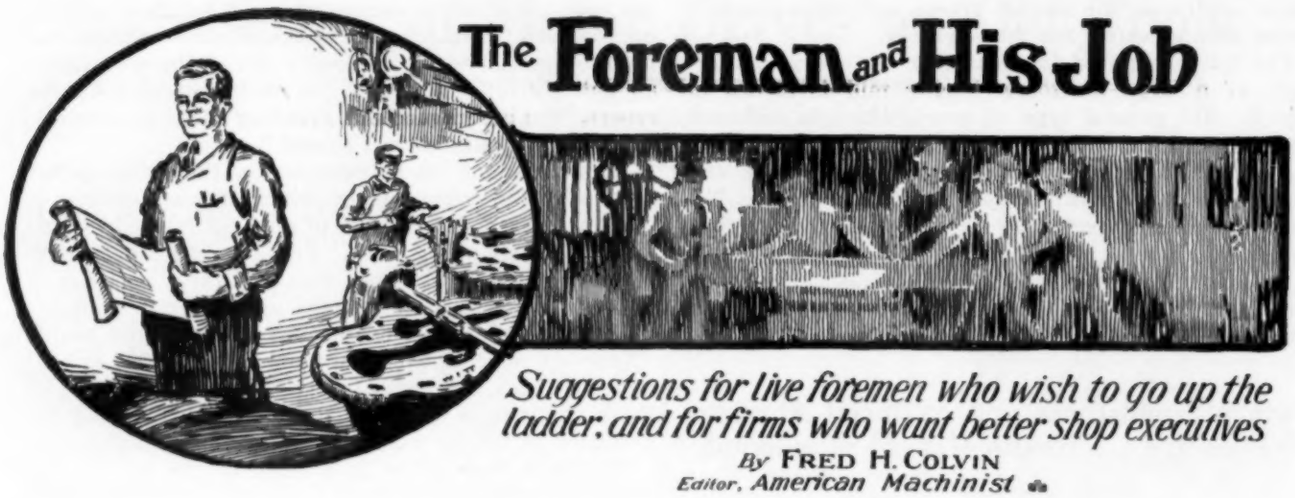
The report explains that the water is ineffective because the men, in order to turn out more work in a given time, do not use as much water as they should, "and in grinding a heavy object like an axe upon a wheel of soft natural sandstone, the workman presses so heavily upon the wheel that the superficial film of water is pushed back behind the axe and the outer surface of moist stone is ground off, exposing a dry surface which in turn is abraded and discharged as atmospheric dust."

There is one other feature which is not described in the report but which helps explain the great difference in the amount of dust produced by the two methods. This is the greater life of the artificial grinding wheel. Such a grinding wheel of proper grain and grade will outwear at least fifteen natural sandstones of the same size. This means that while grinding a certain number of axes on a natural sandstone, about fifteen times as much material is worn away as if the same work were done on an artificial grinding wheel.

There is also a decided difference in the structure of the two types of wheels. The material worn away from a sandstone is finer than that worn from a grinding wheel, and for that reason each cubic inch of sandstone material contains more particles of the size which are small enough to be dangerous than are contained in a cubic inch of artificial abrasive wheel material.

From these studies it seems reasonable to conclude that the best way to protect the operators in axe-grinding shops and similar industries from respiratory disease is to replace natural sandstones with efficient artificial grinding wheels and to provide these with proper exhaust systems.

*Reprint No. 616 from "Public Health Reports," October 8, 1920, pp. 2393-2401.



The Foreman and His Job

Suggestions for live foremen who wish to go up the ladder; and for firms who want better shop executives

By FRED H. COLVIN
Editor, American Machinist

THE establishment of a training school is always a difficult problem if it is to be efficient and a paying investment. We must first find out just what we want to accomplish and then decide the best methods of going about it.

As stated in a previous installment, we must first decide what we want to teach, and whether we want the workers to be "one operation" men and women, or want them to have a fairly wide knowledge of the operations in our shop. It may be that we want to teach some but one operation and others three or four operations, while only a few will qualify for our full training course.

Next we must decide whether this training shall be done in a school or in the shop. Here again we find a great variety of opinion, some advocating one method and some the other. In some cases it will doubtless be advisable to combine the two methods, starting everyone in the school, perhaps, who has had no previous training, and even completing the training of some of those who are to learn only a few operations. The training school has the advantage of getting entirely new workers somewhat accustomed to the machinery before going into the shop itself.

The organization of some shops makes a training school hardly necessary, as there are subforemen in each department to act as instructors right on the job. Where this is possible it frequently has advantages, But in such cases there should be some central point, either in the shape of a general foreman or of a committee, to insure the instruction being along similar lines, with similar aims, at the same time leaving as much individuality as possible to the different instructors or subforemen.

All the instruction should follow a general plan but each instructor should be allowed as much opportunity as possible to be himself, or herself, in the methods used and the way in which the workers are handled. Personality differs widely and some secure results by one method, others by entirely different means. As long as the desired results follow, the exact method should not be too closely questioned or standardized.

One difficulty in training new people, who know nothing of the business, is to assume that they know more than they really do. And if we overlook elementary points we are building on an insecure foundation.

It seems as though anyone might know that it is necessary to have center holes in work or mandrels clean if the work is to run true. And yet there have been many cases where work has been spoiled because these very obvious points were not thoroughly explained and made clear to the worker. We must remember that to the novice the center hole seems just a hole to keep the work or mandrel from falling off the "points" in the lathe. The effect of a chip in the center hole might not even be considered unless we call particular attention to it. It is little things like this which go far to make an instructor a success or a failure.

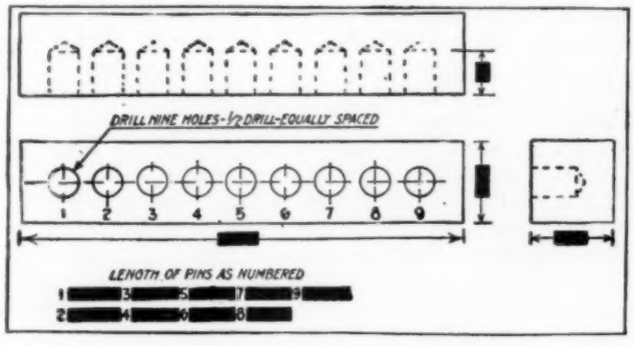


FIG. 1. TEACHING USE OF SCALE

TABLE I. THE EIGHT STEPS IN TEACHING ELEMENTARY INSPECTION

	Hours
Inspection Lesson No. 1— Measuring pins and block with scale and marking sizes on blank blueprint	3
Inspection Lesson No. 2— Measuring plate and holes in plate with scale and calipers and marking sizes on blank blueprint	1½
Inspection Lesson No. 3— Using scale for measuring plate and thread pitch gages and scale for measuring threaded holes in plate and marking sizes on blank blueprint	1½
Inspection Lesson No. 4— Using scale and thread pitch gages for measuring threaded plugs and marking sizes on blank blueprint	1½
Inspection Lesson No. 5— Measuring pins with snap gages and marking sizes on blank blueprint	1½
Inspection Lesson No. 6— Measuring pins with snap gages and marking sizes on blank blueprint	3½
Inspection Lesson No. 7— Measuring bevel gears with protractor, scale and calipers and marking sizes on blank blueprint	1½
Inspection Lesson No. 8— Inspecting test shaft with gages used on all previous inspection points; also marking all sizes and notes on blank blueprint	4
Total	18

Don't be afraid of going into details and always tell *why*. No matter if some do not understand the reason, all who do are going to be better workers for knowing it.

Take any job you give a new worker and analyze it from start to finish. Make a list of every move you make, everything you do. No matter if these moves

TABLE II. TIME OUTLINED FOR STUDENTS IN GIRLS' PREPARATORY SCHOOL AND DIFFERENT OCCUPATIONS TO WHICH THEY CAN BE TRANSFERRED

Occupation	Time, Days
Engine-Lathe Operators—	
Elementary inspection	2
Engine lathe	8
	10
Milling-Machine Operators—	
Elementary inspection	2
Plain milling machine	6
	8
Hand-Screw Machine Operators—	
Elementary inspection	2
Hand-screw machine	7
	9
Barber-Colman Gear-Cutting Machine—	
Elementary inspection	2
B-C gear-cutting machine	7
	9
Hand-Milling Machine—	
Elementary inspection	2
Hand-milling machine	6
	8
Sensitive Drill-Press Operators—	
Elementary inspection	2
Sensitive drill press	5
	7
Heavy Drill Press—	
Elementary inspection	2
Heavy drill press	5
	7
Multiple and Radial Drill—	
Elementary inspection	2
Multiple and radial	6
	8
Tapping-Machine Operator—	
Elementary inspection	2
Tapping machine	5
	7
Tool grinding-Machine Operators—	
Elementary inspection	2
Universal grinding machine	6
	8
External Grinding-Machine Operators—	
Elementary inspection	2
External grinding machine	5
	7
Internal Grinding-Machine Operators—	
Elementary inspection	2
Internal grinding machine	5
	7
Splining Machine Operators—	
Elementary inspection	2
Splining machine	5
	7
Lo-Swing Operator—	
Elementary inspection	2
Lo-Swing lathe	7
	9
Fox Lathe Operators—	
Elementary inspection	2
Fox lathe	6
	8
Potter & Johnson Operators—	
Elementary inspection	2
Potter & Johnson	7
	9
J. & L. Operators—	
Elementary inspection	2
J. & L. machine	9
	11
Broaching Machine Operators—	
Elementary inspection	2
Broaching machine	5
	7
Inspection—	
Elementary inspection	2
Practical inspection	8
	10
Bench Work—	
Elementary inspection	2
Bench work	8
	10
Major Assembling and Dynamometer Test—	
Elementary inspection	2
Major assembling	7
	9
Minor Assembling—	
Elementary inspection	2
Minor assembling	6
	8
Welding—	
Elementary inspection	2
Welding	14
	16
Stock Tracers—	
Elementary inspection	2
Stock tracing	6
	8
Tool-Crib Attendants—	
Elementary inspection	2
Tool crib	6
	8
Foremen Clerk—	
Elementary inspection	2
Clerking	5
	7
Soldering—	
Elementary inspection	2
Soldering	5
	7
Stockroom Clerk—	
Elementary inspection	2
Premium and Production Clerks—	
Clerking	10

seem obvious and in the kindergarten class—remember it is all new and all Greek to many.

If you wipe off the lathe center; wipe out the center hole in the mandrel; oil the tail center; set the tool just at the center; have the carriage in a certain position; use a certain speed and feed; use cutting compound—in fact no matter what you do—make a list of them all, so that you will not overlook a single thing when you come to instruct a new worker. And don't forget to give the "reason why" in every case where there is even a possibility of its not being readily understood.

The following from the Packard Training School method of training girls should be helpful in outlining ways and means along other lines.

The Packard Training School

Those in charge of the school have found by trial that the best results were obtained on machine and assembling work by having one instructor to every three students, and in exceptional cases one to every two. In the elementary instruction one instructor to every six students worked satisfactorily. No matter what department the students were to enter, two days were devoted to elementary instruction in every case, it being found that a knowledge of measurement was a decided advantage in all departments. This preliminary work was accomplished at suitable benches at one end of the shop, everything being done to make the new students feel at ease in their new surroundings. The elementary instruction course is outlined in Table I, while Table II shows the various departments for which workers were trained and the time found necessary in each case.

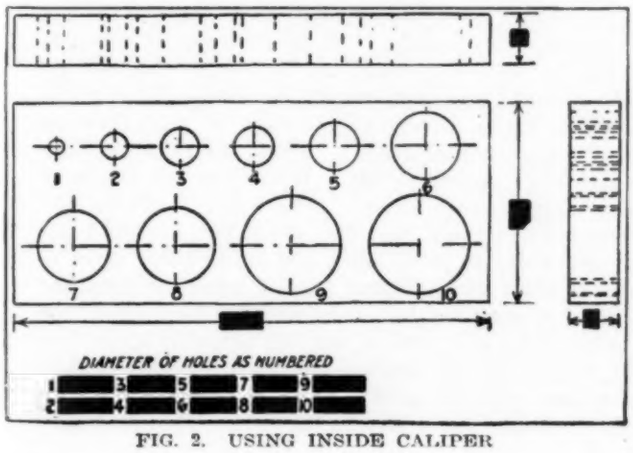


FIG. 2. USING INSIDE CALIPER

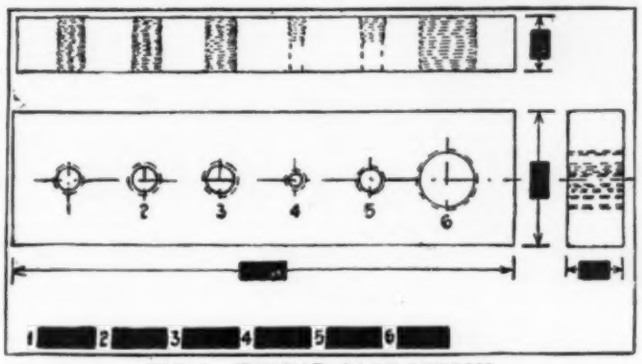


FIG. 3. THREAD GAGE LESSON

The elementary instruction course outlined in Table I consists in learing the use of such measuring tools as scales, micrometers, calipers, depth gages, bevel protractors, thread pitch gages, radius gages, etc., and the reading of blueprints. This was accomplished by means of a combination of blueprints and the articles themselves, some of these being shown in the illustration.

Fig. 1 shows a metal block with nine ½-in. holes equally spaced and drilled to a uniform depth which the student is required to measure. Each block is fitted with pins of varying lengths, the variations being in even eighths, sixteenths, thirty-seconds, and sixty-fourths of an inch. This

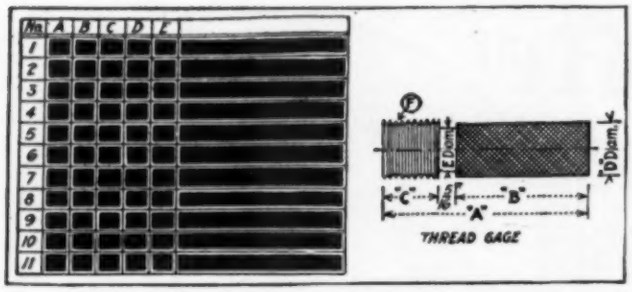


FIG. 4. MEASURING PLUG THREAD GAGE

lesson involves only the use of the scale, as the diameter of the pins is not considered, but only the various dimensions of the block and the length of the different pins. A blueprint is provided with blank spaces for recording each measurement to be made and this answers the double purpose of making it easy to put down the answers and to familiarize the new student with blueprints and drawings.

Lesson 2 involves the use of the scale as before and also the inside caliper, as the dimension of each hole is called for in the blank spaces shown in Fig. 2. The use of thread gages, simply for determining the lead of the screw, is shown in Fig. 3, the plate having four holes tapped straight

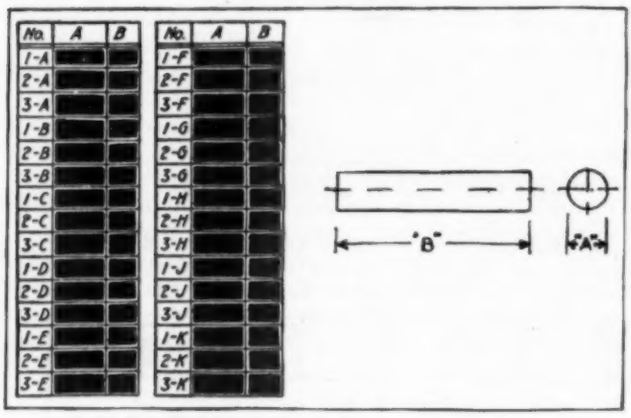


FIG. 5. MEASURING WITH MICROMETER

through and two holes with a taper type thread. More complicated measurement is taken up in Lesson 4, which is a plug thread gage, Fig. 4, and on which six separate measurements are taken. A number of different plug thread-gages are used in this lesson, a blueprint being provided for eleven such gages, should it be desirable to use as many as this.

The blueprint for Lessons 5 and 6 is shown in Fig. 5. In addition to the blueprint there is a block containing ten

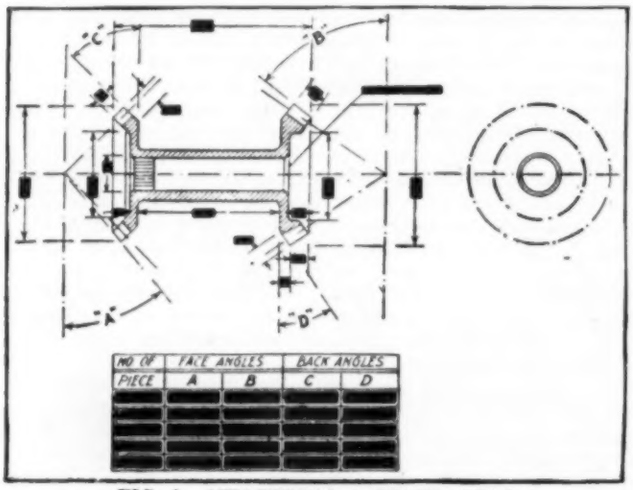


FIG. 6. MEASURING A BEVEL GEAR

sets of three plugs each, every plug being numbered and lettered according to the designation shown. The student here learns the use of a micrometer in a practical way. One of the plugs of each set is the standard size for that set and the other two vary by a thousandth of an inch in each direction. That is, one plug is a thousandth of an inch too small and the other a thousandth too large. In this way the student learns the functions of the micrometer and how to use it, becoming more or less familiar with it in a comparatively short time. The instructor shows how the instrument is handled and how the measurements are read, but does not inform the student of the variations between the different sizes of pins, so that it becomes a real test of

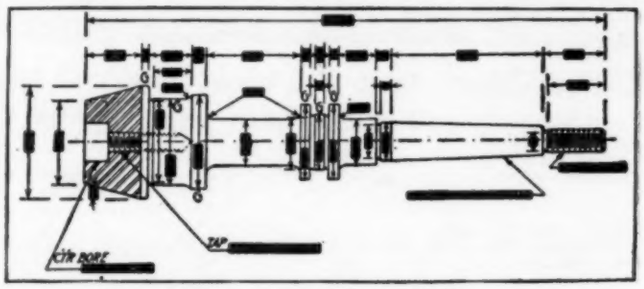


FIG. 7. THE LAST LESSON

measurement with enough repetition to insure fair familiarity with the micrometer.

Fig. 7 shows the use of the bevel protractor in connection with bevel gears, and also includes the use of the scale and caliper, all dimensions being marked down on a blueprint, Fig. 6, as before. The last lesson is a combination of all the others and is a very complicated one for the beginner, as can be seen from Fig. 7. Thirty-nine different measurements are taken and blanks are provided on the blueprint for each dimension. Included in this is the measurement of counterbores, tap holes, bevel gear angles, diameters at the bottom of grooves, and at the outside of shaft and collars. This lesson gives an excellent foundation for mechanical training.

Don't Shirk

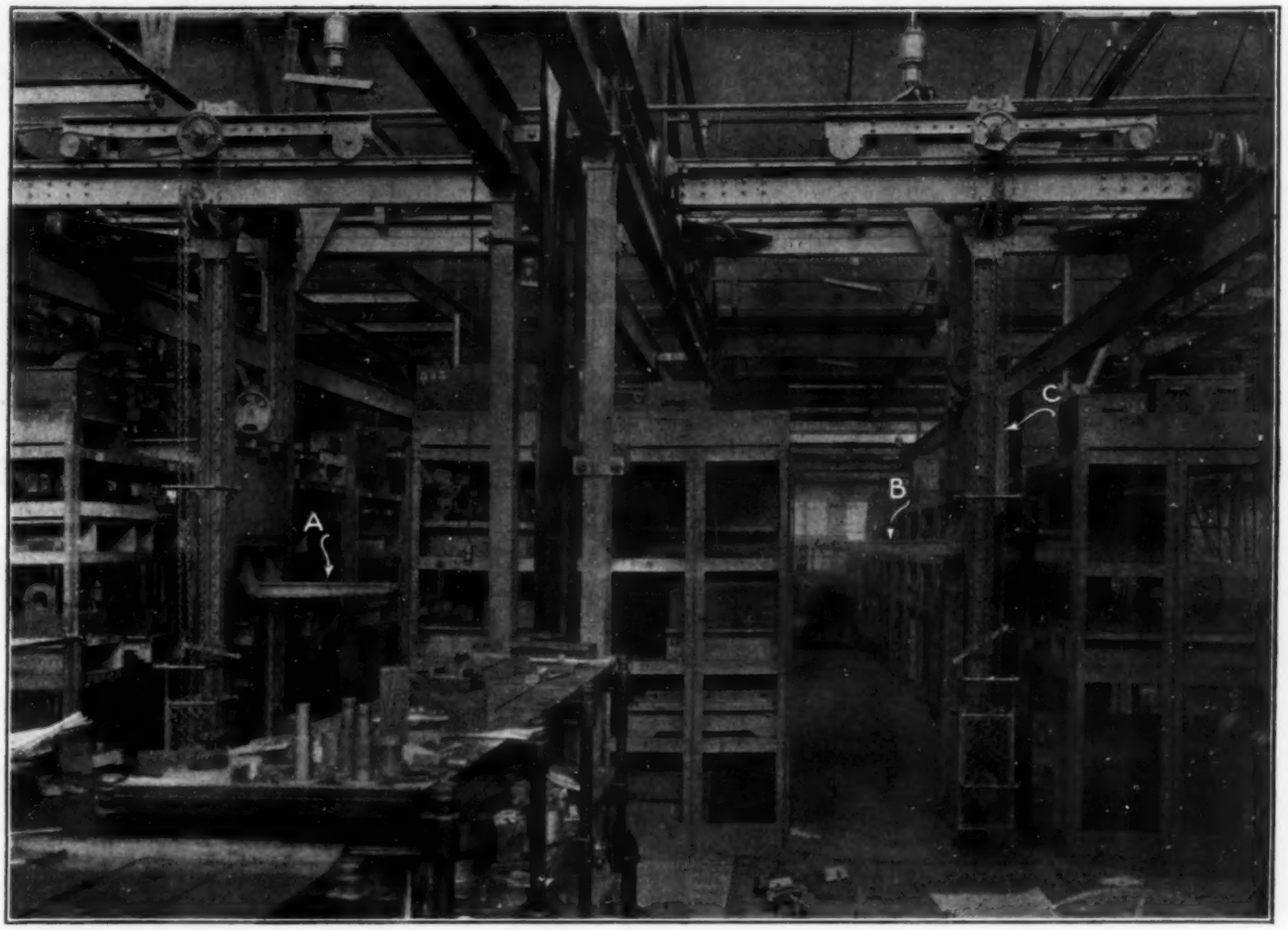
Have you given any consideration to the advantages or disadvantages of the proposed tax on sales? The subject will figure prominently before long. Business men, therefore, should give it all possible study, for they are the ones who will be most directly affected. The importance of such a levy may be deduced from the amount a sales tax is estimated to yield; the figures run all the way from one billion dollars to three billion dollars. An association has been formed to spread information, or propaganda, in favor of a law embodying this tax. There certainly is need for more enlightenment. It sounds very simple to say that all that is necessary is to pass a brief measure imposing a tax of 1 per cent on every bill of goods sold. Should the tax apply if one sells his home? Should it apply if one sells securities? Would it mean an impossible burden on certain finished products which pass through quite a number of hands during the process of transforming the raw materials into goods? Would the sales tax bear very lightly on poorer people? Would the wealthy have to bear a reasonable share? These are intricate and troublesome questions. But does it not behoove the business community to investigate and study them so as to be able to voice an intelligent verdict when the proposed legislation comes up for discussion? Remember, the politicians who will vote on the bill probably know less about the merits or demerits of such legislation than hard-headed business men. The country cannot afford to take so important a leap in the dark.—*Forbes Magazine* (N. Y.)

Jig and Fixture Storage

A Well-Planned Method of Storing Jigs and Fixtures—Efficient and Compact Elevator Greatly Reduces the Difficulty of Handling Heavy Units

SPECIAL CORRESPONDENCE

THE storage of jigs and fixtures, particularly when they run into large sizes and heavy weights, is quite a problem in many shops. The solution worked out by the Cincinnati Milling Machine Co., Cincinnati, Ohio, and illustrated herewith, has many advantages. The fixtures are placed on regular trucking platforms and handled from the machine on an electric motor shop-truck, which carries them from the machining department to the elevator of a concrete storage building. Here the truck and fixtures are taken up on the elevator and delivered to the proper point in one of the cross aisles so as to be handled by the special tiering crane shown.



TOOL STORAGE BINS AND TIERING CRANES

After a fixture with its platform has been deposited on the floor, one of the lifting arms shown at *A* and *A* is lowered to the proper position and moved under the platform by easy manipulation of the small overhead crane and its trolley. The platform is thus easily picked up and carried to the proper bin. It is then pushed into position by means of the overhead trolley, the lifting arm is lowered sufficiently to place the platform on the shelf, lowered still more to release it, then withdrawn to be ready for use at any other point.

These are special tiering cranes, each having a capacity of 1,500 lb. They are provided with electric power hoists, hand control and hand traverse both for the bridge and trolley. The lifting arm is in reality made double and in the form of a bell crank, the other side of the arm *B* being shown turned up against the column at *C*. The bell crank is so pivoted that either arm can be brought down to a horizontal position and in this way it can handle platforms on either side of the vertical column. The arrangement is very compact, requires a minimum of space between the different tiers of racks and is proving very satisfactory in every way.

The racks are substantially constructed of standard angles and parts and the whole arrangement lends itself to almost any condition where heavy fixtures are to be handled and stored. A similar plan could easily be provided for storing finished parts. The use of the platform makes possible both horizontal and vertical handling without loss of time.

This is one method of reducing the overhead or nonproductive costs which are too great in many of our shops. Modifications of this plan should be useful in many places.

Ideas From Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

An Improvised Boring Mill

SPECIAL CORRESPONDENCE

One way to make a lathe serve as a boring mill, not only with the bar between centers as has often been done in jobbing and repair shops, but to bore transverse holes as well, is shown in the pictures accompanying this letter.

The part for which the device was fitted up is the frame of the Greenerd arbor-press, and there are four holes to be bored at the one setting; the hole for the ram, two holes for the pinions and one for the intermediate shaft. The device has been built upon a standard engine lathe from which the cross-slide has been removed and the casting *A*, Fig. 1, bolted in its place. No other change was made in the lathe except to remove the tailstock, and to substitute a spur gear for the crankhandle by which the carriage was traversed and mount the crankhandle with a pinion on its shaft in a special bearing in the apron. This makes the handle

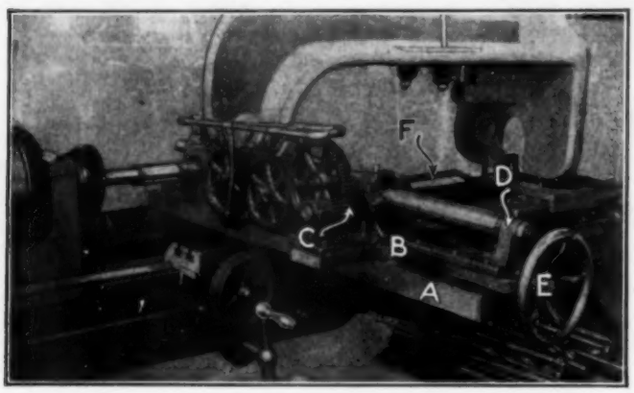


FIG. 1. IN POSITION FOR BORING UPPER PINION HOLE

turn the wrong way, but the operator soon gets used to that.

A plate *B* carries the bearings in which the long pinion *C* turns, and also a bearing that supports the driving quill that transmits the power to the boring-bar spindle when boring the transverse holes. Plate *B* has no movement apart from the lathe carriage when once set for the hole it is to bore, but, being located by a tongue fitting a groove in part *A*, it has three positions in which it may be set, corresponding to the locations of the three holes to be bored. Part *D* is gibbed to part *B* and is moved by the crossfeed screw, turned by the handwheel *E*. Part *D* supports the end of the boring-bar spindle in a suitable thrust bearing and thus provides the means of feeding the boring tool to the cut.

A spur gear is substituted for the usual driving plate on the nose of the lathe spindle and drives the boring-bar spindle through the train of spur gearing, the long pinion *C*, and the bevel gear upon the end of the quill. The outer end of the boring bar turns and slides in a bushing supported in a stationary bracket bolted to the base plate *A*. This can be seen to better advantage in Fig. 2, which shows the same set-up from a different angle. In this latter picture a core-drill is shown in place for the first operation. After taking out the sur-

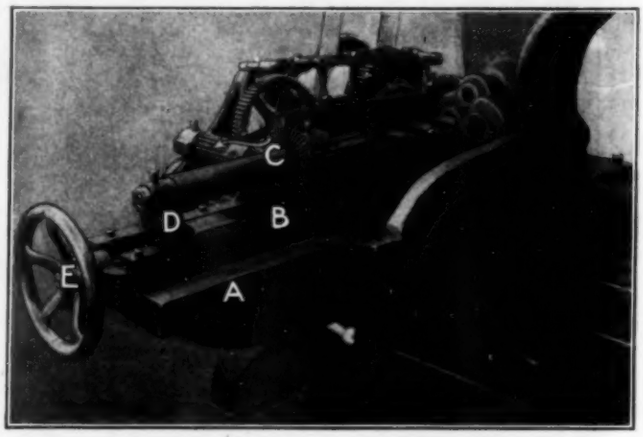


FIG. 2. SAME SET-UP FROM THE OTHER SIDE

plus stock with the drill, the bar is substituted and the hole finish-bored.

After finishing the first hole the part *B* is lifted from the base and set in position for boring the second hole in the same horizontal plane, the tongue that located it now fitting into another groove in part *A*. The same tools are used. To bore the center hole, which is in a different plane, a raising block is used which has tongues fitting both grooves in part *A*, and upon its upper surface a groove to take the tongue of part *B*. The length of the pinion *C* allows it to mesh with its driving gear in

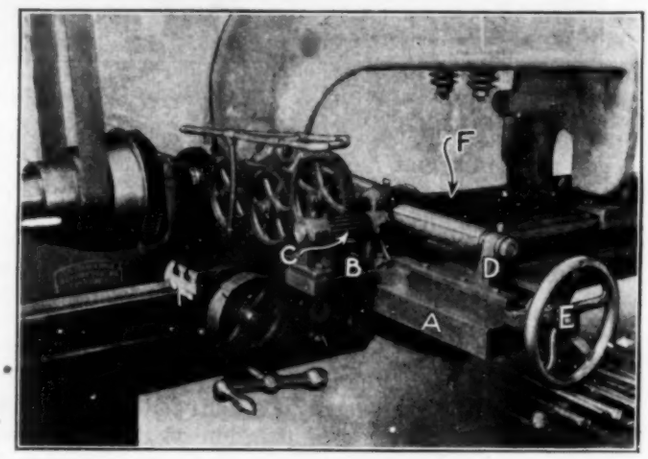


FIG. 3. BORING THE HOLE FOR THE RAM

all three positions and no adjustment of the lathe carriage is necessary.

In Fig. 3 may be seen the method of boring the hole for the ram. The lathe carriage is moved away from

the headstock and the boring bar inserted in the lathe spindle. The outer end of the bar in this position is carried in a bushing as may be seen in Fig. 2. The foot of the press frame is supported by leveling screws upon an auxiliary carriage attached to the main carriage by the reach-rod *F*. This auxiliary carriage has no other function than to support the weight of the work.

Boring bars and core drills are provided for all sizes of holes to be bored and each has a taper shank to fit either spindle. When a frame is once located and clamped on the carriages all holes are finish-bored without disturbing a clamp or adjusting screw, so that the accuracy of the work, both as to relative location and squareness, depends entirely upon the care expended in building the fixture; leaving no chance for error to result from incorrect setting.

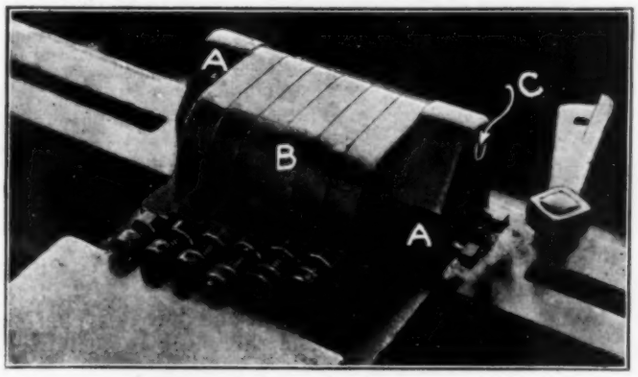
The rig was devised by Mr. Bartlett in whose shops the Greenerd arbor-press is built.

Multiple-Stop for Cross-Slide of Engine Lathe

BY MILTON WRIGHT

A multiple stop that is adapted to almost any engine lathe is shown in the accompanying illustration. It is a valuable aid to the operator when such a lathe is to be used to produce many duplicate parts having several shoulders on each.

The part *A* is machined to fit over the dovetail of the carriage in the rear of the cross-slide, and is provided with a short gib and two setscrews by which it may be held in any desired position. The leaves *B*—six, in this



MULTIPLE STOP FOR ENGINE LATHE

instance—finished on both sides and fitted nicely between the ears of the part *A*. They may be made of cast iron, of cold-rolled steel, or any piece of scrap material that may be convenient.

A hole is bored through the leaves, as well as the ears of part *A*, to take the pin *C* so that the leaves may be swung back out of the way, and each leaf is provided with its own stop screw and locknut. As the actual stop takes place against pin *C*, care must be exercised in the fitting.

The lathe to which the device shown is attached is used for rough-turning lathe spindles preparatory to grinding. The spindles have six diameters and when the stop screws are once adjusted, the entire lot of work may be run off without further measuring except for the purpose of keeping tabs on the tool wear. When regrinding of the tool is necessary, it is reset by means of the compound slide to cut the same diameter as it was cutting before removal.

On this particular job the work is started with all the leaves but one thrown back out of the way. The work, before coming to this operation, is marked off for the locations of the shoulders. The operator runs the cross-slide up to the shortest stop and turns the smallest diameter as far as the first mark. If as in this case, the amount of material is more than can be removed in one cut, two or more cuts may be taken; the depth of each preliminary cut in accordance with the operator's judgment of what the tool will stand, and the final cut made with the cross-slide in contact with the stop.

On reaching the mark that indicates the first shoulder on the work the cross-slide is withdrawn far enough to allow the next longer stop to drop into place and the movements repeated until all diameters are turned. As the exact location of the shoulders is determined in a later operation, at which time the shoulders are undercut for the grinding wheel, the rough turning is accomplished very quickly.

The device is adaptable to many manufacturing operations in the engine lathe, and being quite simple and inexpensive, a number of them may be made up, thus providing for many operations without the necessity for tedious resetting. To set up for a certain job, the size of the first shoulder on the first piece would be established by means of scale and caliper in the usual manner, when the stop would be slipped into place with the shortest leaf bearing against the cross-slide, and the setscrews tightened.

Special Indexing Fixture on P & W Semi-Automatic Milling Machine

SPECIAL CORRESPONDENCE

A special indexing device that converts a Pratt & Whitney semi-automatic milling machine into a full automatic for the purpose of cutting the pinions that are a part of the Greenerd arbor-press, is here shown and described. It was designed and constructed by Edwin E. Bartlett, maker of the above mentioned press.

The object of the device was primarily to provide a rigid and unyielding support to the pinions so that three pinions could be cut at once, accurately and without chatter, though driving the machine to the limit of its endurance.

The construction of the fixture is perhaps better observed in the rear view, Fig. 1. A single heavy casting provides at one end a support for three long spindle bearings and at the other end for outboard supports for the pinions under operation. The inner end of each spindle has a hole to fit the smaller diameter of the pinion, and a key that fits the spline, or keyway, already milled in the pinion, thus insuring not only positive rotation but accurate relationship between the several pinions; for when these pinions are in place in an arbor press—there are two to each press—they have to divide their work between them and any inaccuracy of relationship between pinion tooth and keyway would throw all the work on one pinion.

The outer end of each pinion instead of being supported by a tail spindle, rests in a closely fitting bushing which in turn is held in a bored seat in the fixture. A T-head stud is made permanently a part of each bushing and enters a T-slot below the seat, which T-slot is not parallel with the centerline but inclines downward toward the front end of the fixture so that a bushing is held firmly to its seat by driving it forward. There is

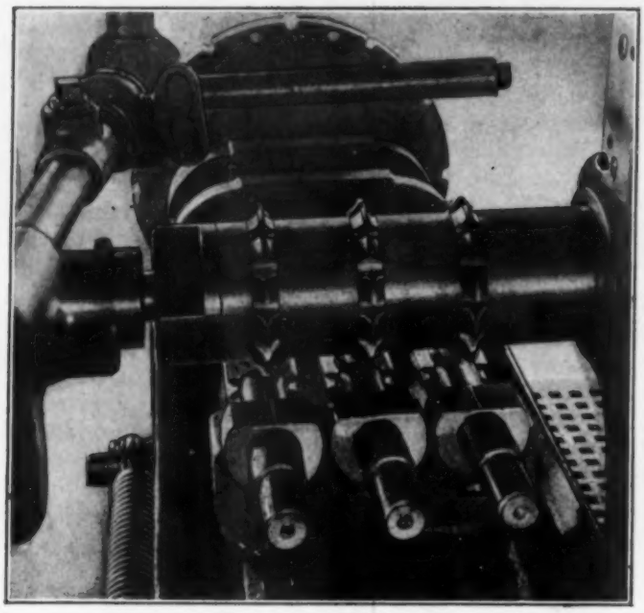


FIG. 1. REAR VIEW OF FIXTURE

no shoulder on the pinion at this end and the bushing can thus be driven to a bearing without being stopped by other limitations.

Fig. 2 shows the spindle end of the fixture and also the special features of the indexing mechanism that have been added to the machine to adapt it to this work. The work spindles are larger in diameter at this end and the shoulders thus formed rest against the frame casting and resist the thrust of the cutters. Each spindle extends through the front of the bearing and has a gear keyed to it that serves to keep the three spindles in proper relation to each other and to impart the rotative movement from the index-plate. The center spindle is longer than the others and the index-plate is keyed to it.

The regular camshaft of the machine is removed and a longer one substituted. Two adjustable cam dogs are attached to the cam disk, one serving to withdraw the locking pin while the other moves the lever A, Fig. 2, to accomplish the indexing movement.

The forward movement of the table is actuated by the

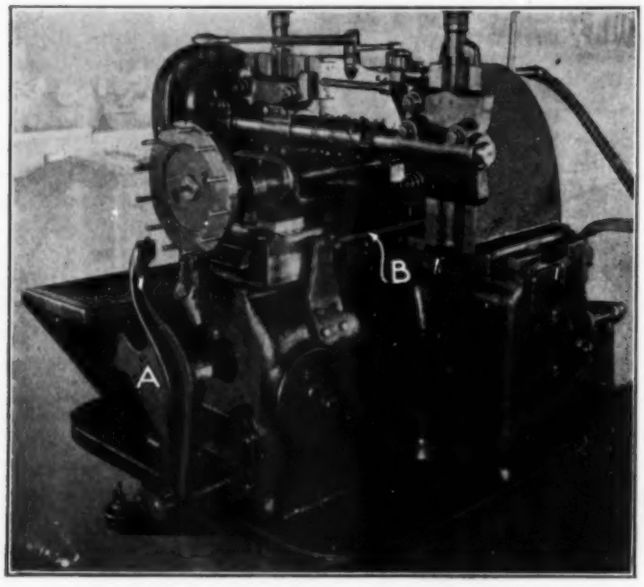


FIG. 2. THE INDEXING MECHANISM

regular cam, which is a part of the standard machine, but instead of the speed-up movement of the camshaft for a quick return the return side of the cam is cut away and the table is brought back to the starting point by the helical spring B. The locking pin is attached to the table and is, of course, at all times in engagement with the index plate except when withdrawn by the cam. As the cam does not move forward with the table the locking pin is, during the greater part of the cycle, entirely out of its sphere of action and cannot possibly be withdrawn at a wrong time by faulty adjustment or slippage of the cam dogs.

The same is true of the indexing arm. Though it remains at all times under control of the cam, it cannot reach the index plate except at the instant the table is returned preparatory to starting a new cut. Therefore, while a faulty setting or a slippage of the cam dogs might serve to render the machine inoperative, it could not by any possibility cause a movement at the wrong time and thus spoil a piece of work.

Once set, the action of the machine is continuous until the three pinions are completed, and requires no attention from the operator. Because of the rigidity of machine and fixture there is practically no vibration or noise, and the finished tooth is smooth and free from chatter marks.

Expansion Stud Arbor

BY ROY A. DRESSLER

The illustration shows a tool that the writer has found to be very useful. Such tools may be made up in sets to cover any range of sizes desired.

The shank is first turned and ground to fit the spindle of the lathe, and the remainder of the machining opera-

AN EXPANDING STUD ARBOR

tions, except the slotting, done while the tool is in its working position.

Briggs standard pipe reamers and taps may be used to advantage for reaming and threading the hole. The plug is squared at one end for a wrench.

The tapered portion of the plug should be made slightly more tapered than the standard reamers, thus leaving the small end about 0.005 in. under the diameter of the hole and give a clearance at top and bottom of thread. If this is not done the plug may bind and the purpose of the tool will be defeated.

A Tap Holder for Use on the Lathe

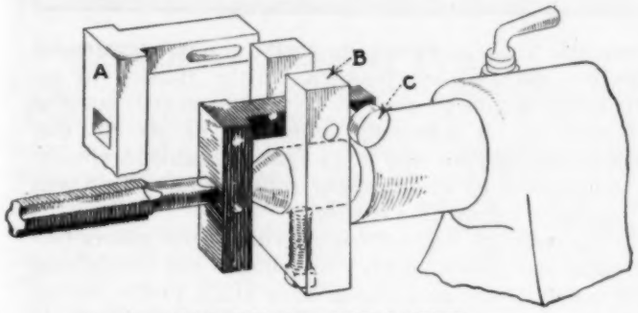
BY HARRY MOORE

When drilling and tapping a large number of pieces in the lathe, the holder shown herewith was made with the idea of providing for the quick removal of the tap to enable the drill to be placed on the center; also to have a certain floating movement for the tap, while at the same time holding it back on the center.

It is made in two parts. Part *A* has a square hole to fit the square shank of the tap, and when both are fitted together they are pinned. Part *B* is drilled to fit the center, tapped for a tightening screw, and slotted to receive part *A*. A pin through *B* and through the slot in *A* completes these two parts.

A knurled head pin *C* through the exposed part of the slot in *A* prevents the tap from falling, while the end of *A*, resting on the spindle of the tailstock keeps it from raising; thus holding it back on the center.

When tapping, the tailstock is loosened from the



TAP HOLDER FOR LATHE

shears. The operator then gives it a shove to start the tap and the whole thing moves up and comes back when the lathe is reversed to get the tap out of the way. The pin *C* is then removed and *A* is pulled slightly forward to clear the spindle and folded back, as it were, till the tap is resting on the body of the tailstock. A flat spot is ground on the center where the tightening screw bears.

Comparison of Cast and Cast-Hammered Babbitt Thrust Washers

By J. M. Henry and F. B. Coyle
Engineer and Metallurgist, Pratt & Whitney Co.

Some time ago the writers were called upon to investigate the relative values of cast and "forged" babbitt thrust washers and the data obtained may be of interest to those who have similar problems.

It had been the practice in our plant to take a piece of babbitt, put it under the drop, and forge it flat, the washer being machined from the blank. This was supposed to give a refined close-grained structure with additional hardness and increased wearing qualities. In another part of the plant, the foreman was casting his washers in a bar—machining the bar to size and cutting the washers to suitable length as they were required. The latter method was much cheaper and the tests were made to find out the advantages (if any) of the "forged" blanks.

Two washers were selected at random from the finished stock. One piece was about $\frac{3}{8}$ in. thick and 4 in. in diameter with a $1\frac{1}{4}$-in. hole in the center. This piece had been machined from a cast bar. The other was about $\frac{1}{4}$ in. thick and the same as the former piece on other dimensions. This sample had been hammered down to required thickness and then machine finished.

A Brinell hardness test with a 250-kg. pressure gave the following results:

DIAMETER OF IMPRESSION

Cast	Hammered
4.7 m/m	4.9 m/m

The hammered piece was the softer and this fact will be referred to again.

A piece of each disk was cut out, polished, etched, and examined under the miscroscope. Both specimens were etched with both nitric and hydrochloric acids to ascertain if the presence of lead in one and absence of it in the other were the cause of difference in hardness, but the indication was that lead was entirely absent.

This metal has the following general chemical composition:

Tin	90 per cent
Antimony	8 per cent
Copper	2 per cent

No analysis was taken of these particular samples and the above composition will not apply stringently. However, the microstructure was typical of the above analysis, that is, cubes of the hard compound of antimony and in (SnSb) in a matrix of eutectic.

Both materials showed that the ingots were the result of excellent casting practice. The cubes of SnSb were evenly distributed and covered about one-third of the section. The particles of compound in the cast sample were intact and had clean sharp edges, but the particles in the hammered piece were greatly distorted and shattered. This data is evidence that the cast metal is the only one desirable for the following reasons: When a material of this nature is in service and subject to wear, the softer eutectic wears away and leaves the hard antimony tin particles in relief. These particles present a good wearing surface and also transmit the pressure to the softer matrix which will sustain vibration and at the same time is just plastic enough to mold itself to the shape of the revolving shaft.

When a piece like the hammered sample is put into service the small shattered particles tear out and score the bearing. Also, the load is not properly supported.

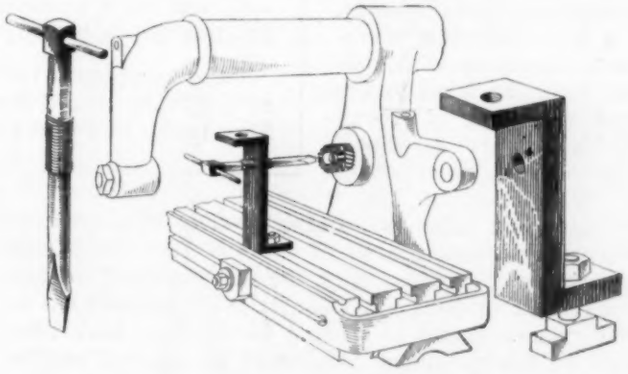
An examination of oil used on these bearings will show that on the cast type the particles will become rounded on the edges before tearing out of the matrix and will barely scratch the surface of the bearing, while in the latter type small angular particles with sharp corners and edges will be found.

Running tests extending over a period of a year have borne out the above analyses and cast washers are now used wherever babbitt thrust washers are called for.

Care of Screw Slots

By Albert W. Leysath

The retaining screws for shell-mill arbors are often abused by being tightened or loosened by means of a punch and hammer. The illustration shows the details



DEVICE FOR PROTECTING SCREW SLOTS

of, and the method of using a device that is simple and efficient.

Care must be taken that the lead on the shank of the screwdriver be made the same as that of the retaining screw. To remove the screwdriver from the screw slot, the table must be backed away from the mill.

IN THIS ISSUE

PRESENT price levels seem to indicate the fulfillment of the predictions made by H. H. Manchester in the article which opens this issue. Written some months ago, before the present downward trend of prices became apparent, it predicted that we may expect to see wages and prices reach a new level by the beginning of 1922, about one-third higher than in 1914. Such a condition would make our price indexes stand at about 133, a figure which the prices of some commodities are rapidly approaching. This article is the first of four that comprise a brief history of post war crises. It gives a résumé of commercial, industrial and financial crises from 1337 to 1860. That the series is going to be of extreme interest is indicated by some of the questions which the author answers, among them: "Where are prices and wages going?" "When are they going to reach there?" "What is going to happen afterward?"

The second article, beginning on page 981, is by George Atwell Richardson of the Midvale Steel and Ordnance Co. It gives the details of an improved method of making steel gear and wheel blanks, a method developed by efforts to manufacture gear blanks, industrial wheels, car wheels, automobile fly wheels and similar pieces of uniform circular sections that would be of superior quality and meet the most severe service requirements. The manufacturing operations, beginning with rolling down the ingot to the final operation of rough machining, are described.

In this week's installment of "Metal Cutting Tools" beginning on page 985, DeLeeuw tells of the cutter sharpening characteristics of cup and disk wheels, the importance of correct angles, the sharpening of cutters, and related subjects. A valuable point brought out is that cutters should be ground before they have been used on the maximum number of pieces that can be machined with one grinding. He states that such a method not only saves the cutter but also makes the workman feel safe in the use of higher speeds or feeds or both. The subject of cutter grinding is important and we think you will decide as we have that the current installment is a very valuable addition to the previous articles of the metal cutting series.

The heat-treating methods used by the Industrial Pneumatic Tool Co. in making parts for Thor pneumatic tools are detailed by Western Editor Hunter in an article that begins on page 991. Proper heat-treatment has come to be extremely important in present day methods and anyone who is up against problems similar to those solved by the company referred to will do well to carefully follow this article.

In our opinion the tool engineering series grows better with each installment. We admire the persistence with which Dowd and Curtis have stuck to the important, but to them probably tiresome, subject of drill jig design. They are not overlooking many bets and when you get together this group of articles on drill jig design you will have something worth while. The current installment takes up bushings, knobs, thumbscrews and ejectors. It tells of the proper design and proportions of bushings; the methods of holding slip bushings; how to properly locate bushings; and shows the various forms of standard knobs, thumbscrews, hand wheels and ejectors. Page 997.

A short article by J. H. Vincent, page 1000, gives a pointer or two in regard to the installation of motor drives on some old railroad shop tools, a planer and boring mill. The installation of motor drives enabled the machines to be set out in the main bay where they could receive overhead crane service. Many shops, by similar installations, can no doubt increase their efficiency a great deal.

"The Foreman and His Job" this week is a little longer than usual. Colvin has taken up the training school as it is related to the foreman and has furnished some exemplary lessons that should be presented to the student. The lessons he gives are a part of the system of the Packard Motor Car Co. Page 1002.

The matter of proper jig and fixture storage has received thorough consideration in many plants but not in as many as might and should be. The article, on page 1005, although brief, describes an up-to-date method of jig and fixture storage and handling that can well be followed by many other shops.

The Shop Equipment News section this week is somewhat larger than the average. The twenty-seven developments described indicate the determination of many manufacturers to be ready for coming business.

Coming Features

Our leading article next week will be on economics. It was written by Doctor Whitney, Professor of Finance, University of Cincinnati, under the title "Obstacles to Business Revival." All of us want to know what the obstacles are, so that we may understand what we are combating. While the statements may appear to some to be somewhat pessimistic, we think that a close analysis will show that while it is a true statement of conditions as they are it shows throughout that progress is being made and that we have in the last year taken a big step toward our destination of a safe and sound business basis.

The same issue will contain the seventeenth of Basset's modern production series and the eighth of the Tool Engineering articles.

There will be another Rolls Royce article, this one taking up connecting rods, and a description of a modern monitor-type shop for building lathes, both by Colvin.

Other complete articles will be "Turbine Work at the Puget Sound Navy Yard" and "Holding Fixtures for Railroad Shop Work."

EDITORIALS

In the Cold Gray Dawn

THE world at the present time is passing through the last stages of "the morning after the night before," with the same demoralization of faculties and the same lack of energy which were characteristic of that pre-Volstead condition. And the apparent delay in recovery is causing considerable concern as to when the old world will be well again, and whether or not it will ever look quite the same.

H. H. Manchester has made a thorough study of industrial and financial conditions both prior and subsequent to each of the more important wars of modern times, and in his article "A History of Post-War Crises" gives a pretty clear idea of what may be expected in the future. Pre- and post-war commercial and industrial conditions have been carefully outlined and comparisons made of both food prices and wages. A study of the facts and figures given will show that "history repeats itself" as evidenced by the fact that conditions at the present time are exactly as outlined in this article.

The Lubrication of Machine Tools

IT SEEMS to be the general complaint that the great majority of machine-tool idleness is due to the lack of proper lubrication. Oil holes so placed as to be difficult of access, and insufficient training or carelessness on the part of the operator both contribute to the neglect and its result.

One remedy is to have machines lubricated by men charged with that specific duty instead of depending on the operator, whose chief incentive is the earnings from his productive efforts. Another is for machine builders to provide more positive methods of lubrication than is usually the case. Geared heads and geared feed boxes have followed automobile practice in many features of design, but few have followed the practice of using forced lubrication on the main bearings.

The problem is not the same, but has many similar points. The main advantage of the automobile is that it distributes its surplus or overflow oil over the road, while, with a machine in a shop the surplus might be annoying. This, however, is not an insurmountable objection.

Machine heads with revolving spindles and shafts are much like motors and transmissions, as both have shafts which extend beyond the case itself. Forced lubrication to the bearings can be accomplished where necessary, and provision made to prevent leakage as is done in automobile motor practice. The keeping of an oil film between the bearing surfaces greatly lengthens the life of a bearing and pressure feed has good features.

The present is a good time to study the question of lubrication with a view toward reducing the damage caused by neglect to find all the oil holes on a machine. Some machine designers have already given this careful consideration, but there is room for improvement in many cases.

Non-Productive Costs

MACHINE-TOOL builders, shop managers and production men are all keenly interested in reducing the cost of production, and rightly so, for much remains to be done in that direction. But the problem of getting business on a normal basis includes much more than shop costs which are often relatively small.

Take, for example, the case of a well known automobile where the production cost is but 10 per cent of the selling price. The car sells for approximately $3,000. The shop builds the motor, transmission, front and rear axles, and many other parts—more in fact than with most cars of similar grade. Yet the actual production cost is less than $300.

Nor does this necessarily mean that an exorbitant profit is being made. The great discrepancy is due to non-productive costs, between the shop and the consumer. These costs may include shop overhead, elaborate cost systems, too much office expense, high selling costs and various other expenses. But as long as these costs exist the shop man can hardly be expected to worry much about reducing shop costs. It also shows the futility of ascribing all our troubles to high wages in the shop. If these men worked for nothing it could not make more than $300 difference in the cost of the car to the consumer.

One has only to recall the days when bicycles were distributed from expensive showrooms and to remember that we paid $150 each for them. Today we buy a better wheel for $40 or less—and the manufacturers, we trust, make a good profit at that. But they have eliminated much of the non-productive costs which formerly existed.

Just how far this condition is true of other lines is known only to those in the various industries. But whether large or small, non-productive costs must receive at least as careful attention as shop costs. They form one of the glaring economic wastes to which Mr. Hoover is so well devoting so much of his attention.

The Need for Simple Airplanes

THE development of the airplane industry depends primarily on the designing and building of planes at a reasonable price. As pointed out by C. F. Kettering, who uses a plane much as most of us use an automobile, the average designer seems to disregard manufacturing costs when designing airplanes and their parts.

Mr. Kettering contends that an airplane motor of 150 horsepower, sufficient for a two or three place machine at least (probably more with efficiently designed wings) should and can be built to sell for $750 and the plane itself for approximately $1,000 more. With planes available at the price of an automobile, the demand will increase, users will demand and cities and towns will provide landing fields, and the industry will begin to get on its feet. This will be more effective than any plan of subsidies, although these may be necessary in some special cases.

Shop Equipment News

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval. Brief descriptions appear later in Condensed Clipping Index in both American and European editions.

H. & G. Threading Machines, Models SS and DS

The Eastern Machine Screw Corporation, New Haven, Conn., has just placed on the market two threading machines designed to hold H. & G. die-heads. The machines are the result of long experiments in the factory of their builder and possess features of individuality.

The center line of the spindles and work carriers is very low, with the result that the torsional strain induced by the cutting tools is kept well within the bed of the machine. The ways upon which the work carriers slide are round bars of tool steel and the corresponding bearings upon the carrier are half bushings of bronze, so that replacement of these parts when worn is very simple and involves little machine work.

The work spindles are hardened and ground, and run in bronze bearings easily adjustable to compensate for wear. Each machine is supplied with an oil pump that delivers the oil or cutting compound to the rear of the spindle, from whence it flows out through the die-head and helps to keep the cutting tools clear of chips.

Change gears provide a means by which the ratio of spindle speed to that of the driving pulley may be changed to suit the requirements of work of different diameters or material. The oil pump is driven directly from the first shaft, so that the flow of oil remains constant in volume irrespective of speed changes.

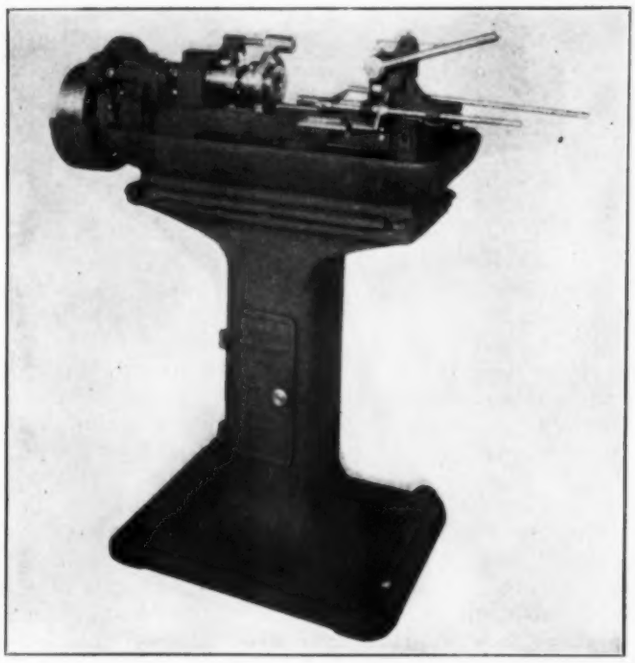


FIG. 1. H. & G. SINGLE-SPINDLE THREADING MACHINE, MODEL SS

The smaller machine has but one spindle and is intended for use either on the bench or on a pedestal, as shown in Fig. 1. The larger machine, shown in Fig. 2, for floor use only, has the same general char-

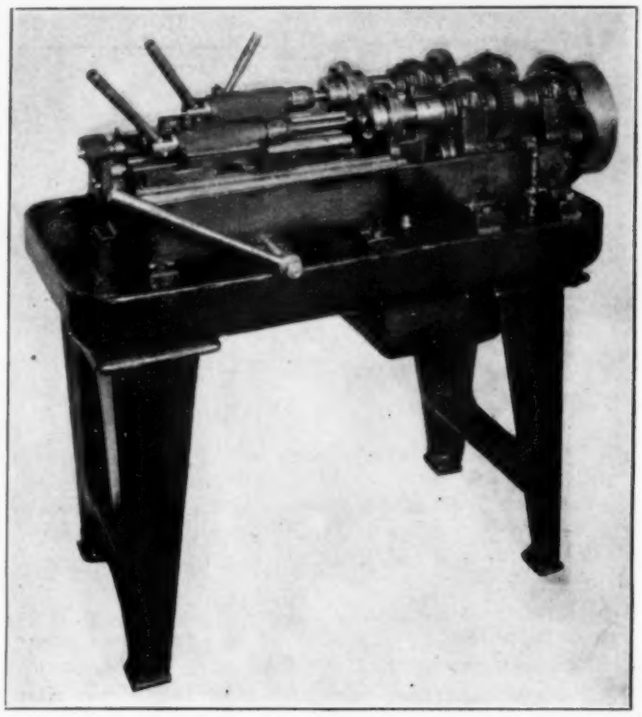


FIG. 2. H. & G. DOUBLE-SPINDLE THREADING MACHINE, MODEL DS

acteristics but with added capacity and power. The work carrier of the single-spindle machine is pushed forward by the same lever that closes the holding jaws upon the work. On the larger machine a rack and pinion movement is added independently to each carrier, and operated through levers at each side of the bed, to assist the operator in advancing heavy pieces of work and entering them in the dies. The opening and closing of the dies in both styles of machine is automatic and demands no attention from the operator. The point at which the dies open and close may be adjusted to suit the work.

Two styles of work carrier are provided. One, with side opening jaws, is shown in place on the single-spindle machine and the other, with spring collets for holding the work, may be seen in the illustration of the double spindle machine, Fig. 2. Either or both styles may be supplied with the machines, as they are interchangeable.

The side-opening feature allows the easy manipulation of long rods that are to be threaded upon the ends. The operator does not have to push the rod

through a hole in the spindle, but may swing it in from the side. In connection with the side-opening jaw slide there is an end stop for positioning the rods so that all may be threaded for the same distance from the end. This stop is actuated by a cam and the operator need pay no attention to it further than to push the end of each rod against it before closing the jaws, as it will get out of the way of the die-head automatically.

For threading short pieces, or studs that are to be threaded on both ends, the collet work holder is more convenient. The holding feature of either style of work carrier is operated by one lever, a single movement of which is all that is required to grasp the work and, in the case of the smaller machine, to advance it to the dies. On the larger machine the side lever and rack and pinion movement may be used, if necessary, to assist the operator in entering large pieces in the dies.

The smaller machine has only a single spindle and a capacity for threads up to 1¼ in. in diameter by 9¾ in. long. The gear ratios are 2:1 and ½:1. The bed and pan are cast in one piece and adapted to use on the bench. The machine occupies a space of 14 x 36 in., and when mounted upon the pedestal for floor use the height from the floor to the center line of spindle is 38½ in. The machine is regularly equipped with countershaft and one die-head. Any die-head from ¼ up to 1¼ in. may be used.

The larger machine has two spindles with five gear ratios ranging from 1:1 to 9:1, and will take the H. & G. die-heads from ⅞ to 1½ in. in size. This machine is made only to stand on the floor, where it occupies a space of 29¾ x 45½ in., and stands 38 in. from the floor to the center line of the spindles.

Jones No. 3 Horizonal Boring and Drilling Machines

The accompanying illustrations show the Jones No. 3 horizontal drilling machine, also the horizontal drilling and boring machine developed from it, both of which are built by the Jones Machine Tool Works, Philadelphia, Pa.

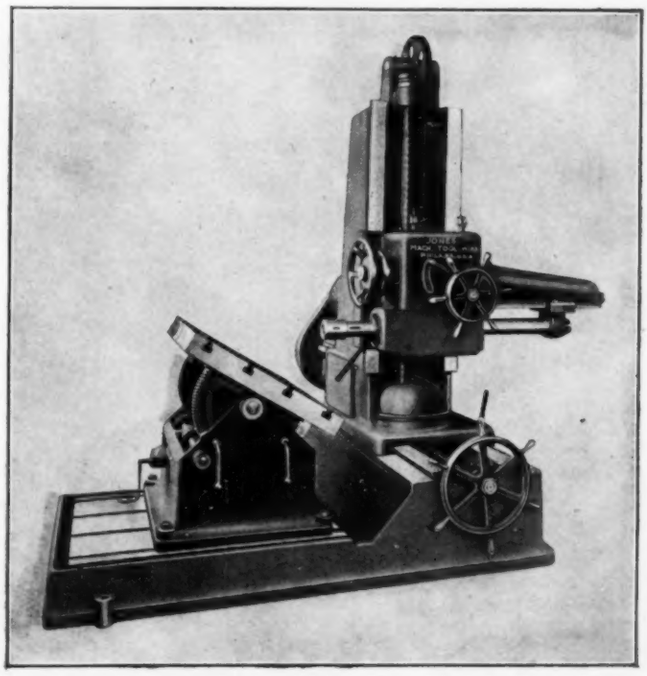


FIG. 1. JONES NO. 3 HORIZONTAL DRILLING MACHINE

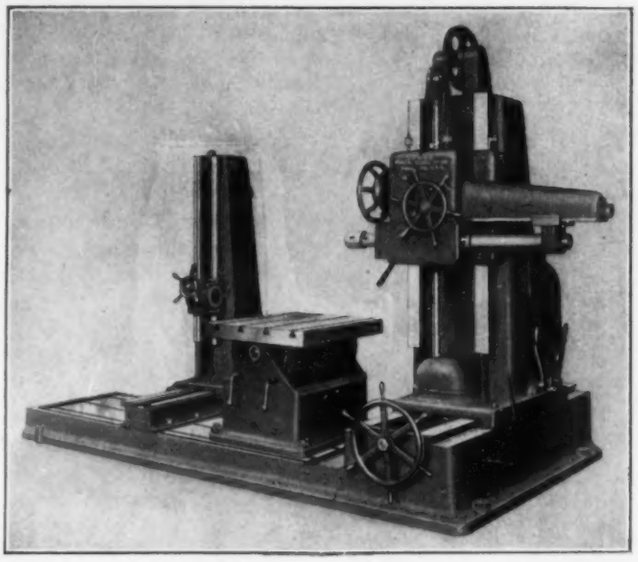


FIG. 2. JONES NO. 3 HORIZONTAL BORING MACHINE

The horizontal drilling machine, Fig. 1, is made standard or portable, in which case the base part for the table is omitted. The machine is driven by a 3½-hp. variable speed motor with six change speeds through gearing located in the base of the column and flood lubricated. The change speed levers, which are located on the side of the column, can be set to give spindle speeds of from 20 to 700 r.m.p. The spindle is 3 in. in diameter and is bored for a No. 5 Morse taper shank. It has a traverse of 20 in. and is operated by the handwheel through a steel screw and bronze nut at the back of the wheel. The friction clutch for the feed spindle is supported by three bronze bearings, two of which are in the saddle and one in the slide. The spindle thrust is received by large thrust ball bearings.

The saddle, which is counterbalanced, has a vertical traverse of 30 in., the horizontal traverse of the column being also 30 in. Both saddle and column are hand operated, although facilities for quick traverse are provided. The table is 30 in. square and can be tilted 45 deg. from horizontal in either direction. The overall dimensions are 92 x 68 in. x 104 in. high. Weight, 9,500 pounds.

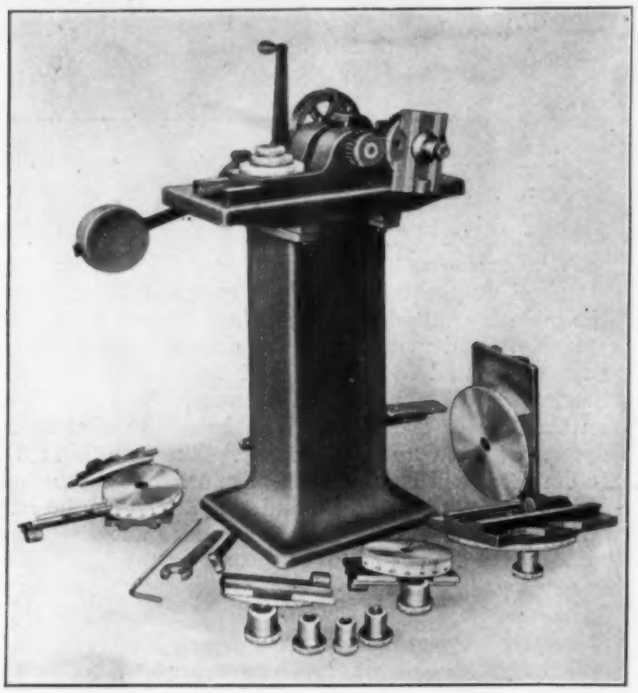
The No. 3 horizontal boring and drilling machine, Fig. 2, is similar to the machine described above except that the base, which is longer, supports the outer support column and runway for supporting the boring bar and facing head when boring cylinders, etc. The table shown is replaced with a universal rotary table which tilts in one direction only from horizontal to vertical. The table top is 36 x 48 in., and can be rotated in either direction when locked in the desired position. Weight, 12,500 pounds.

Noble and Westbrook Graduating and Marking Machine

The Noble and Westbrook Manufacturing Co., Hartford, Conn., has recently placed on the market the graduating and marking machine shown in the illustration. Either hand- or power-driven machines can be furnished as desired. On the power-driven machine, the placing of pieces of work in the machine and removing them when the operation has been performed are the only duties required of the operator. With the hand machine,

one turn of the handle completes a piece of work. Provision is made for holding the work in the proper relation to the graduating die and the depth of the marking is controlled by means of a treadle, cam, and weight which are governed by a positive stop that is adjustable to provide for marking the lines to any desired depth.

The machine is equipped with steel spindles and adjustable bearings. The operation of the marking die is controlled through a clutch on the spindle. The range of work for which the machine is adapted is illustrated by the pieces shown around the machine. Parts of various diameters can be graduated by changing the position



NOBLE AND WESTBROOK GRADUATING AND MARKING MACHINE

of the intermediate gear located on the adjustable section. The graduating and numbering are completed in one operation. Full equipment for the machines, including the engraved marking dies, can be furnished.

Webster & Bennett Duplex Boring and Turning Mill

A boring mill of the duplex type as shown in the accompanying illustrations has been introduced by Webster & Bennett, Coventry, Eng. The turret-heads and tables can be run at different speeds, as they operate independently. This machine is made in two sizes, the 20-in. size, shown in Fig. 1, and the 42-in. size, shown in Fig. 2.

The machine is driven by means of single pulleys fitted with friction clutches so arranged that the speed change gears cannot be changed or shifted until the clutch has been released. Positive horizontal, vertical, and angular feeds are provided and are reversible and interlocking. Rapid power traverse in all directions is instantly available.

A feature of the machine is the feed safety clutch, which is held in position by means of a powerful spring and is set to take the pressure exerted by the heaviest given tool. Any pressure beyond this causes the clutch to slip and so prevents damage to feed mechanism through accident or carelessness. Ball-thrust bearings are provided for all feed screws and worms.

The turret is balanced by compensating springs in-

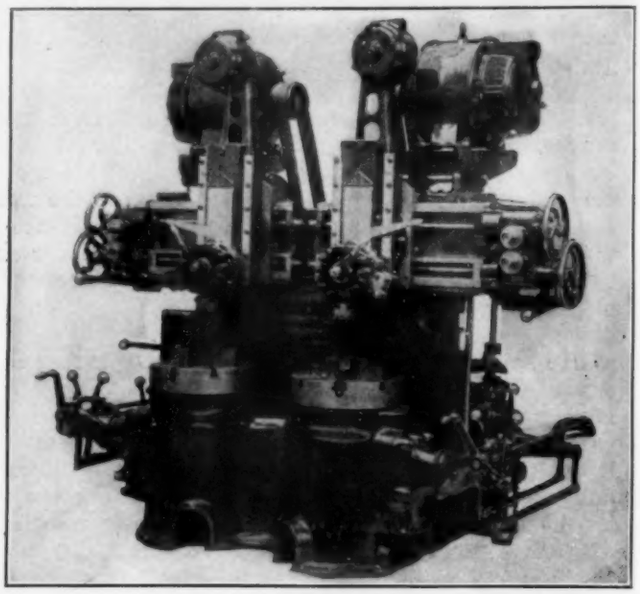


FIG. 1. WEBSTER & BENNETT 20-IN. DUPLEX BORING AND TURNING MILL

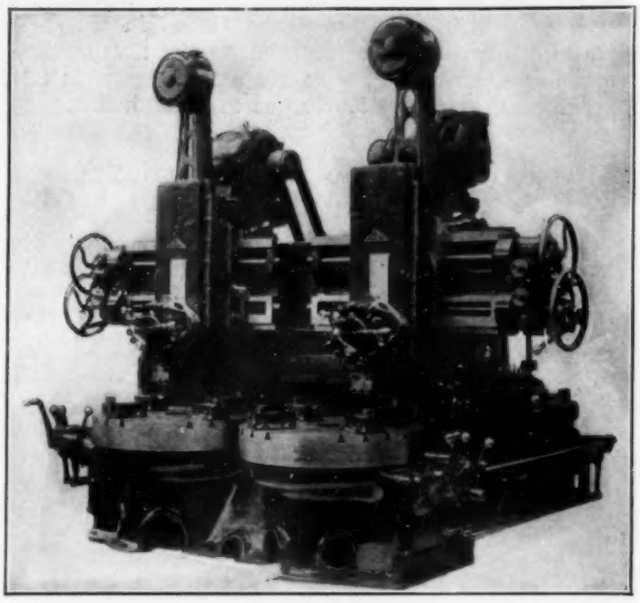


FIG. 2. WEBSTER & BENNETT 42-IN. DUPLEX BORING AND TURNING MILL

stead of weights and chains. Tension is adjusted by means of a revolving wormshaft on top of the balance box. The control is centralized, all levers being accessible from the operator's position at the side of the table. Two levers control automatic feed and rapid traverse in all directions. The machine can be supplied with motor drive if desired.

Tosi Crankpin Lathe

Turning the crank bearings on large multi-throw crankshafts, such as those used in stationary and marine engines, is ordinarily a difficult task, because of the cumbersome shape of the pieces. Several special ma-

chines for the purpose of machining the shafts have been made, Fig. 1 showing a machine recently built for this purpose by the Franco Tosi Societá Anonima, Legnano, Italy.

The construction of this lathe, in which the tools are held by a big hollow mandrel that revolves around the piece to be turned, is said to allow the machine to stand all the stress produced by the use of the best high-speed-steel tools.

The main parts of the machine form two separate rigid sets, the fixed one composed of the bench and the mandrel head, and the other composed of the slide, the two supports to hold the shaft to be turned and the shaft itself. The latter set, shown more clearly in Fig. 2, during the working travels longitudinally across the first set on long guides on the bed. This design makes the slide move so that the work obtained is perfectly cylindrical.

The bed is of strong and heavy construction, and the mandrel head is placed across it. In order to obtain the centering of the piece which is to be turned, the head can be moved transversely by hand and afterward rigidly blocked in the position required.

The hollow mandrel toolholder, having the shape of a ring, turns in the interior of the fixed head, running with great smoothness between half-conical bearings which can be adjusted, see left side of Fig. 3. The arrangement provides for a continuous circulation of cooling oil between the head and the mandrel, keeping the bearing surfaces perfectly lubricated at the same time. Thus expansion caused by the overheating of the head and the mandrel through friction is avoided, a necessary construction in a mechanism of this kind. The view on the right in Fig. 3 shows the construction.

The machine is intended to be driven through gears connecting with an electric motor. The speed-change gears are encased, so as to run in oil, and they give five different speeds to the mandrel. The engagement and the disengagement of the motor are obtained by friction clutches. The slide can be moved either by means of the four power feeds through a quick-shifting mechanism, or by hand with a micrometrical device.

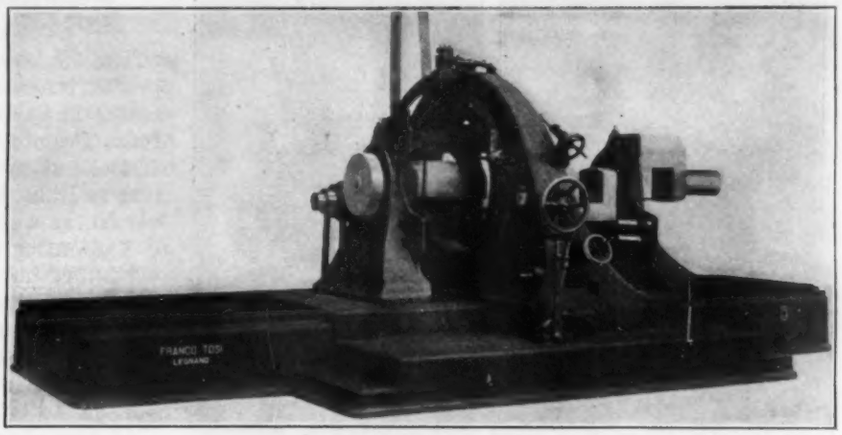


FIG. 1. TOSI CRANKPIN LATHE

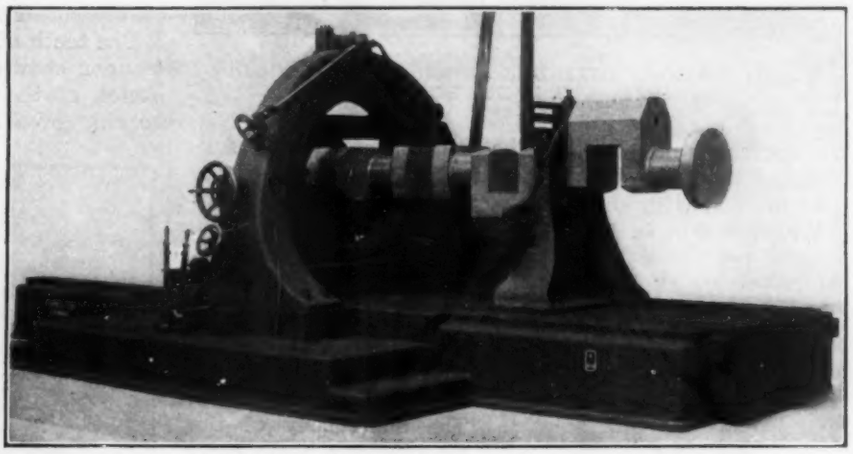


FIG. 2. CRANKSHAFT MOUNTED ON TOSI LATHE

The tools, which are moved in a radial manner, are fixed to special supports, held by two cross-head beams fixed on the hollow mandrel and shown in Fig. 1. Their movement, which can be regulated while the machine is in action, is obtained by a screw and a ratchet gearing, which slides on two helical segments.

All levers and gear handwheels are in a central position, within easy reach of the workman, and a platform at the front of the machine facilitates both operation and survey.

Specifications: Internal diameter of mandrel, 1,400 mm. (55.119 in.). Maximum diameter of pin to be turned, 600 mm. (23.623 in.). Maximum radius of useful cutting, 710 mm. (27.953 in.). Height from the slide face to center of mandrel, 1,120 mm. (44.095 in.). Horsepower of motor, 15. Bench: length, 7,000 mm. (275.59 in.); width, 3,000 mm. (118.112 in.). Approximate weight, 35 tons.

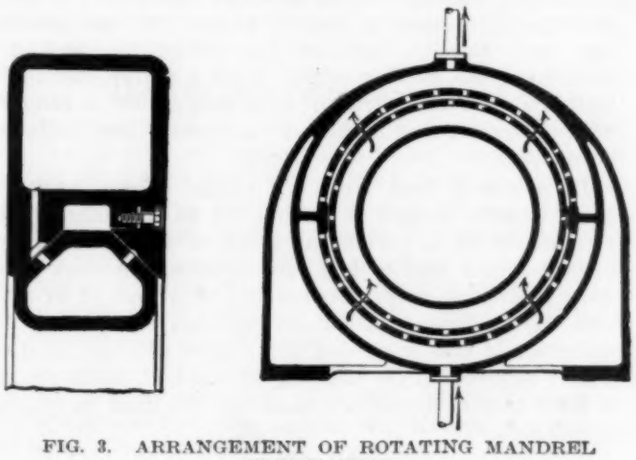


FIG. 3. ARRANGEMENT OF ROTATING MANDREL IN THE HEAD

Phoenix Cylinder Reboring Machine

The cylinder reboring machine, shown in the accompanying illustrations, has been recently placed on the market by the Phoenix Manufacturing Co., Eau Claire, Wis. The machine is designed for the purpose of reboring motor cylinder blocks and is fitted with a cutter head that is said to be especially adapted for this work.

By the use of the attachments which are supplied, the machine can be used either as a hand machine, as shown in Fig. 1, or with power as shown in Fig. 2. The cylinder can also be rebored without removing it from the chassis. The boring bar operates in an adjustable bearing, 13½ in. long, by means of which accuracy of

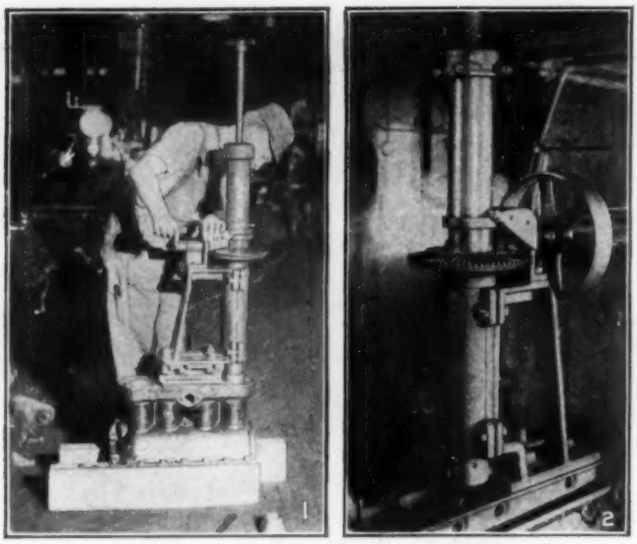


FIG. 1. PHOENIX CYLINDER REBORING MACHINE RUN BY HAND. FIG. 2. POWER OPERATED

alignment is maintained. The cutter head, which is furnished with each machine, is adjustable from 3⅜ in. to 4¼ in., and with an extra set of blades will bore cylinders up to 5 in. in diameter. The machine weighs 160 lb.

Storm Type M Reboring Machine

The illustration shows the Storm Type "M" Reboring Machine, built by the Storm Manufacturing Co., Minneapolis, Minn., for use in reboring motor cylinders.

STORM TYPE M REBORING MACHINE

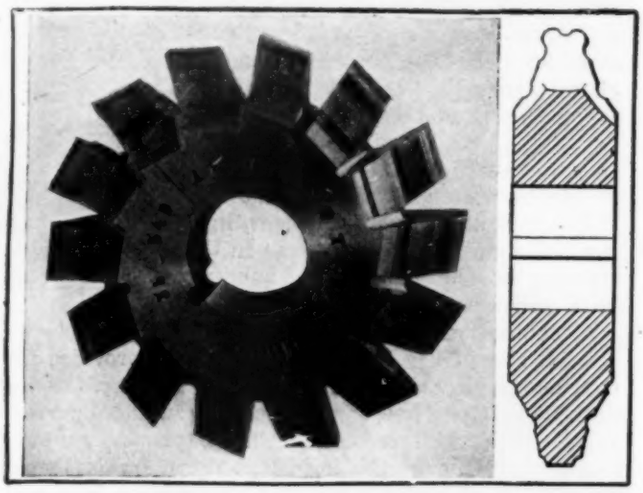
The main body of the machine is a heavy casting which supports the boring bar, feeding and driving mechanism. The boring bar is of hollow carbon steel and is supported by two heavy adjustable bearings. It has a travel of 14 in. The cutter heads are of the Storm patented six-cutter type, which have universal adjustment by means of a central cutter adjuster. The machine is regularly furnished with a connection for a drilling machine, but can also be furnished with a belt pulley or with motor drive. Each machine is also provided with a double-end wrench for operating by hand so that it may be removed from the base and used for reboring motors without taking them from the chassis. The feeds used for boring are 40 and 8 revolutions per inch of travel of the boring bar. The total capacity of the machine is from 2⅜ to 6½ in. and the weight approximately 300 lb.

Bonaffous-Bozonnet High-Production Gear Milling Cutter

The illustration shows a formed milling cutter for production work in the cutting of gear teeth. The cutter in various kinds and profiles is made by Bonaffous, Bozonnet & Co., St. Ouen, near Paris, France. It looks at first sight like a roughing cutter; but it is not, as it is stated that a very smooth finish can be obtained, as well as a correct profile.

The cutter is not relieved on a relieving or backing-off lathe, but on a special milling machine. As can be seen by the view on the left, the relieving is straight instead of curved, as is the case in the ordinary gear cutter. The cutter is not ground with the tooth faces radial, but in such a way that the tooth face is kept parallel to a certain diameter line through the tooth, this procedure being necessary in order to keep the profile of the gear teeth correct. The line is scratched on the cutter for one pair of teeth.

The teeth of the cutter are nicked alternately, in the manner shown by the top and bottom portions of the sketch at the right of the illustration. These nicks, or chip breakers, are said to prevent chatter and to



BONAFFOUS-BOZONNET GEAR-MILLING CUTTER

allow each tooth to remove a certain amount of metal. The principal advantage of the cutter is said to lie in the method of relieving. With a cutter relieved on the backing-off lathe, after cutting a number of gear teeth, a flat surface begins to wear at the point and on the sides of the tooth near the cutting edge. The rubbing of this flat surface on the metal of the gear blanks to be cut has a braking action which goes on increasing very rapidly, causing the cutter to heat and destroying the cutting edge. With a cutter having its teeth relieved on a straight line, this action is reduced, with the result that higher cutting speeds and feeds can be adopted.

It is stated that with the cutter shown, cast-iron spur wheels, module 9 (about 1¼ in. circular pitch) can be cut at a peripheral speed of 55 to 60 ft. per minute and a feed of 8 in. per minute, the work being done in one cut only. Ordinarily, 12 wheels of 57 teeth and 3¼ in. wide can be cut without sharpening the cutters. If this work had to be done with an ordinary cutter relieved on the backing-off lathe, it would require a more powerful machine than the one used in the test mentioned.

Jones Vertical Shaping and Slotting Machine

The machine shown in the accompanying illustration is a vertical shaping and slotting machine which has recently been placed on the market by the Jones Machine Tool Works, Philadelphia, Pa. This machine is made in two sizes, with 6 or 10-in. stroke, and can be furnished equipped for either belt or motor drive. Power is transmitted through a friction clutch and a set of sliding gears, which allow three speed changes for the 6-in. machine and four for the 10-in. machine. The machine is equipped with the McCord quick-return mechanism, which is flood-lubricated, as are also the change gears.

Power feeds for the saddle, cross-slide and rotary tables are of the intermittent ratchet-feed type. The cross-slide and saddle have micrometer dials graduated in thousandths for fine adjustment. The rotary table is graduated to 360 deg. and has an indexing plate with spring stop for accurate spacing. Quick indexing is also a feature of the table, which can be rotated $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$ or $\frac{1}{12}$ of a circle. The 10-in. machine is equipped with quick power traverse to the saddle, cross-slide and table.

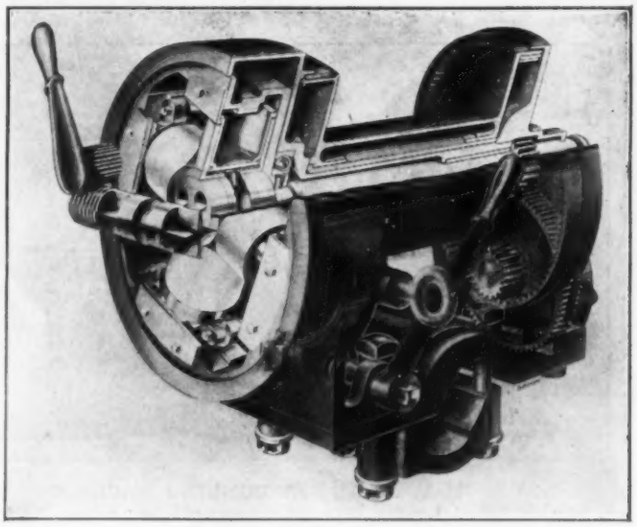
JONES VERTICAL SHAPING AND SLOTTING MACHINE

Denver Air-Operated Hoist

The illustration shows a sectional view of the Model 250 Waughoist, an air-operated hoist recently placed on the market by the Denver Rock Drill Manufacturing Co., 39th Ave. and Williams St., Denver, Col.

The Waughoist is designed on the principle of a rotary engine, and the whole engine revolves within the motor housing, which is an oil and air-tight casing protecting the engine from the atmosphere and also serving as an oil reservoir.

The spider-shaft, upon which the cable drum revolves, is a heat-treated alloy steel shaft. Fixed to the spider-shaft is the spider which revolves within the motor-housing. Around the inner side of the spider are mounted four hardened and ground steel tracks on which the piston rollers run. A clutch pinion is mounted on the small end of the spider shaft so that the cable drum gearing can be disconnected from the engine and the drum permitted to run free when desired. The hoist can be reversed instantly. All gears are heat-treated steel.



DENVER AIR-OPERATED HOIST

Specifications: Brake horsepower, 5.0 at 100 lb. air-pressure. Hoisting capacity, 500 to 1,000 lb. hoisted vertically at the rate of 68 to 143 ft. per minute, depending on weight of load. Drum capacity, 755 cu. in. of rope space which will accommodate 1,000 ft. of $\frac{1}{4}$-in. rope, 465 ft. of $\frac{5}{16}$-in. rope, or 225 ft. of $\frac{3}{8}$-in. rope. Mounting, fits either 4- or 4$\frac{1}{2}$-in. column. Size of air connection, 1$\frac{1}{4}$-in. hose or 1$\frac{1}{4}$-in. pipe. Gearing, 18 to 1 or 27.5 to 1, at option of customer. Length, 24$\frac{1}{2}$ in. Height, 19$\frac{1}{2}$ in. Width, 17$\frac{1}{2}$ in. Weight, 335 lb. Shipping weight, 400 lb.

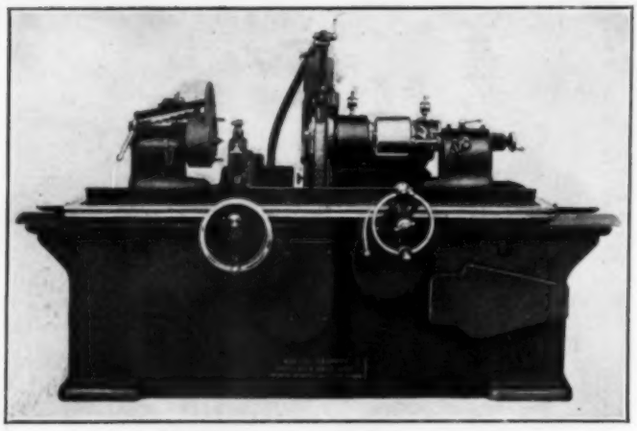
Norton Autopart Regrinding Machine

The Norton Co., Worcester, Mass., has just placed on the market a special type of grinding machine designed for automobile regrinding shops. This machine, which is shown in the accompanying illustration, is so arranged that the various set-ups required can be very easily and quickly made, making it adaptable for the regrinding of crankshafts as well as the grinding of pistons, piston pins, valves, etc. It has a swing of 18 in. and is 55 in. between centers, which will accommodate practically all makes of crankshafts. With the twelve work speeds provided, grinding can be performed on work of small as well as large diameter.

The base is heavy and rigid, and is supported at three points. This method of support makes it unnecessary to provide special foundations for the machine, and insures permanent alignment.

The wheel slide weighs about 900 lb. and is equipped with a 26-in. diameter grinding wheel so that ample clearance will be provided when grinding crankshafts for long stroke motors. The headstock and footstock are of standard Norton type except that they are somewhat heavier and have longer bearing surfaces on the table. A large capacity pump is supplied which is driven directly from the overhead works.

The Norton standard wheel feed mechanism is used consisting of a 3$\frac{1}{2}$-in. diameter feed screw engaging with a half nut underneath the wheel slide. The wheel slide rests on one flat and one V-way. The movement of the feed index pin one space advances the slide one-eighth of a thousandth of an inch. The table is operated by a two-speed hand-feed apron.



NORTON AUTOPART REGRINDING MACHINE

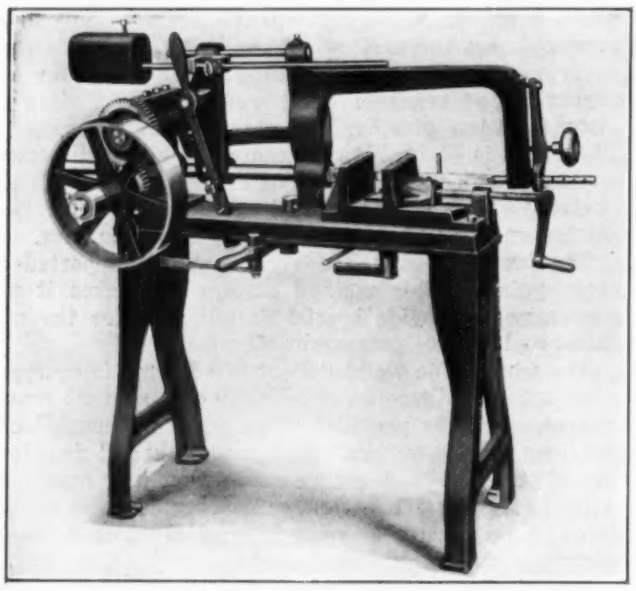
Specifications: Length between centers, 55 in.; swing, 18 in.; weight of headstock, 240 lb.; range of work speed, 20 to 207 r.p.m.; weight of footstock, 160 lb.; weight of wheel slide, 900 lb.; length of bearing ways, 24½ in.; length of spindle, 28¼ in.; large bearing, 3½ in. diameter, 8 in. long; small bearing, 3 in. diameter, 6 in. long; diameter grinding wheel, 26 in.; net weight of machine, 7,600 pounds.

In order to provide for the many types of crankshafts which the regrinding shop handles, an adjustable end-block is furnished which eliminates the use of blocks and bushings for fastening different diameters of shafts in the fixture.

A combined center and valve-face grinding attachment is also furnished with the machine. By the use of this attachment the machine centers may be raground. The attachment is adjustable, permitting the regrinding of the faces of all types of valves

Frontier Power Hacksaw

The Frontier Machine Tool Co., Inc., 128 Lakeview Ave., Buffalo, N. Y., announces a small power hacksaw, which is shown in the accompanying illustration. The



FRONTIER POWER HACKSAW

Specifications: Length of blade, 8 to 14 in. Stroke, 6 in. Cutting capacity, 5½ x 6 in. Vise: opening, 5½ in.; jaws, 4½ x 3 in. Pulley, 11 x 2¾ in. Floor space, 36 x 18 in. Weight: net, 215 lb.; crated 235 lb.

saw is belt-driven and provided with an automatic stop and a positive clutch in the driving mechanism. A speed reduction of two to one is made in the gearing, the normal speed being 65 strokes per minute.

Motor Drives for Bradley Hammers

The hammers built by C. C. Bradley & Son, Inc., Syracuse, N. Y., can now be furnished with electric motor drives. The drives are not direct, but through belts, as may be seen in the accompanying illustrations.

In the case of the compact hammer shown in Fig. 1, the motor is mounted on a bracket attached to the upright. The cushioned helve hammer shown in Fig. 2 has the motor on a separate foundation at the side of the machine. The application of motors and belts is clearly shown in the illustrations.

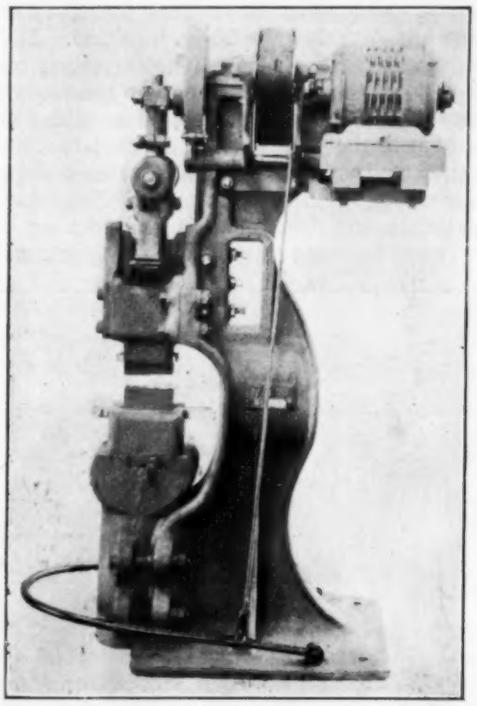


FIG. 1. BRADLEY COMPACT HAMMER, MOTOR DRIVEN

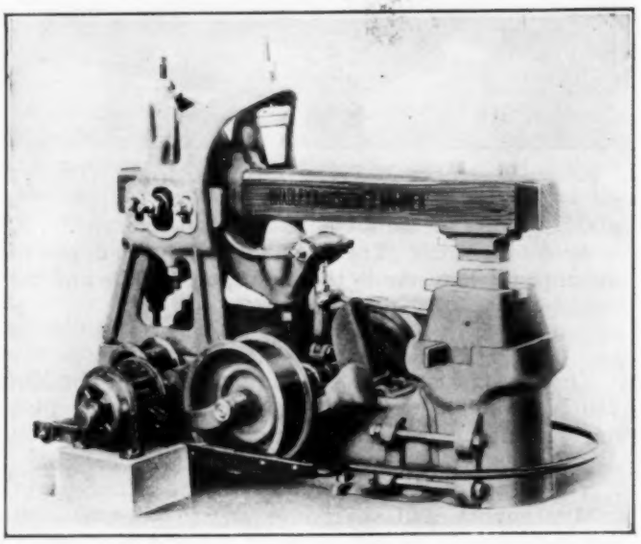


FIG. 2. BRADLEY CUSHIONED HELVE HAMMER, MOTOR DRIVEN

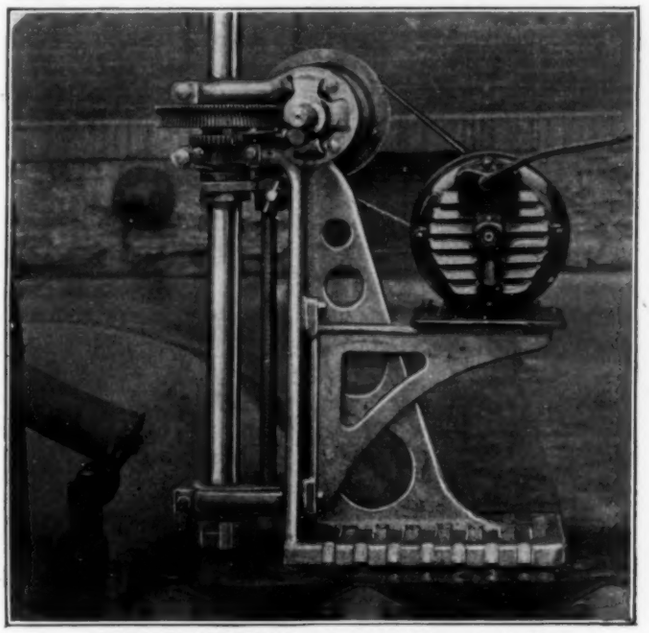
Motors for alternating or direct current and with various voltages, phases and cycles can be furnished.

Keeler Cylinder Reboring Machine

The Central City Machine Co., Syracuse, N. Y., has placed on the market the cylinder reboring machine shown in the illustration herewith.

This machine is for use in garages and repair shops for reboring automobile cylinders and is built on an angle plate intended to be secured to the top of the cylinder block. It is motor driven and when in use there is no necessity for removing the engine from the automobile. The boring bar is worm driven and runs in bronze bearings split to take up wear.

Three cutter heads are furnished as part of the regular equipment and will bore from 2¾ to 4½ in. Each head has five high-speed steel cutters centrally adjustable by means of a five-lobed cam, so that any amount of over-size can be obtained for any size of cylinder. The bottom of the cutter head is slightly conical, so that the head can be centered in the cylinder bore before the machine is clamped in place.



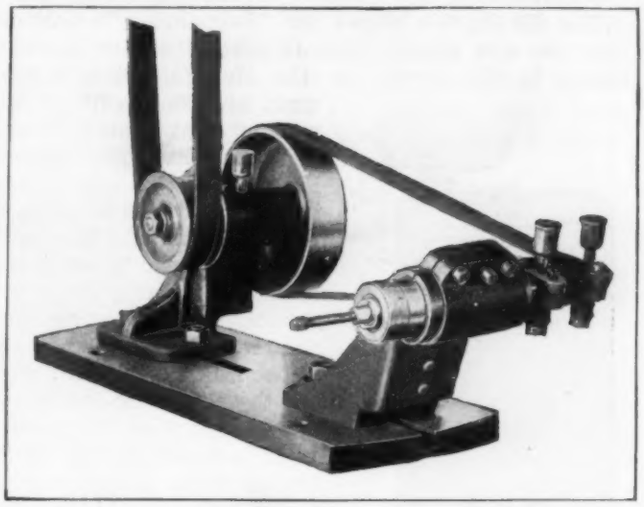
KEELER CYLINDER REBORING MACHINE

Specifications: Diameter of boring bar, 1½ in. Speeds, one. Feeds, two. Motor ¼ hp. for a.c. or d.c. as required. Floor space, 20 x 11 in. Height, 23 in. Weight, 72 lb.

An adjustable limit stop is provided which will stop the motor when the cutter heads have reached a predetermined depth.

Hjorth Internal Grinding Attachment

The illustration shows the Hjorth internal grinding attachment which has been placed on the market by the Hjorth Lathe and Tool Co., 27 School St., Boston, Mass. It is said that the attachment can be used on practically any of the plain or universal grinding machines now on the market. It has the ceiling countershaft adjustment and a table center adjustment of 2½ in. for accommodating different center heights, also its own countershaft belt adjustment between quill bracket and countershaft. The quill spindles are of two types, one for deep and large holes and one with taper arbors for small holes, accommodating smaller emery wheels and diamond grinding plugs. Each quill spindle has two adjustable bearings, lubricated by oil chambers, and a separate adjustable end thrust bearing. The countershaft spindle is well supplied with oil chambers and with two bearings of its own and is driven by a clutch to a live spindle, thereby relieving the strain from the live spindle.



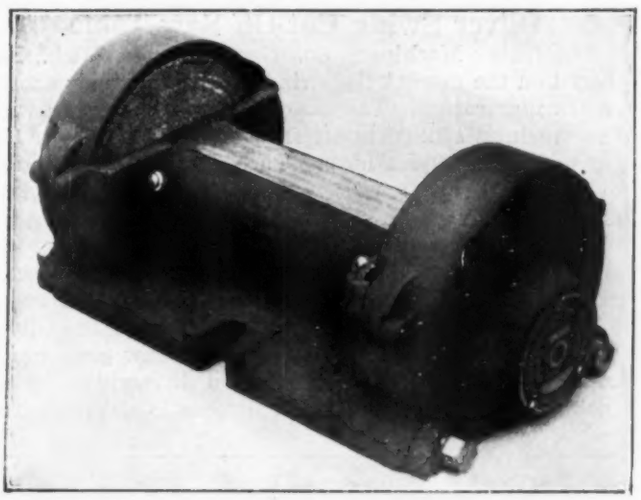
HJORTH INTERNAL GRINDING ATTACHMENT

The attachment is provided with open slots in the base to facilitate easy adjustment and firm holding.

"Precision" No. 23 Truing Machine

The accompanying illustration shows the No. 23 truing machine, which has been placed on the market by the Precision Truing Machine and Tool Co., Cincinnati, Ohio. The machine is similar to the Precision No. 21 machine, but is made for larger grinders such as the Blanchard and Norton surface grinders with wheels up to 6-in. face.

The machine carries wheels 4 in. in diameter with 1 in. face. One of its outstanding features is that a wheel, when not in use, is thoroughly protected by a hinged wheel guard, as the illustration shows. Another is that two different grades of wheels can be carried at the same time, making it possible to use one machine on a number of surface grinding machines when different classes of finish are required; or one wheel can be used for roughing and the other for finishing the same grinding wheel. The machine is equipped with ball bearings.



PRECISION NO. 23 TRUING MACHINE

Economizer Ice-Cooled Drinking Fountain

The illustration shows the "Economizer" combination ice- and water-cooled drinking fountain recently placed in the market by the Manufacturing Equipment and Engineering Co., with office at Boston, Mass., and plant at Framingham, Mass. The principal feature of the device is the fact that two coils and two cooling compartments are used, although ordinarily ice-cooled fountains utilize but one coil for the circulation of water in the ice compartment. One of these cooling compartments with a coil immersed in it is cooled by ice, while the other is cooled by the water which is ordinarily wasted during drinking and which has been thoroughly cooled. The combined length of the coils carrying the drinking water is 105 ft., the coils being made of copper. It is stated that the retaining of the wasted cool water and the utilization of it for cooling the water inside the coils effects a considerable saving in the amount of ice necessary to cool the drinking water. This waste water circulates about the lower or primary coil and is kept cool by the continued replenishing of it by the wasted water from the bowl below the bubbler.

ECONOMIZER ICE-COOLED DRINKING FOUNTAIN

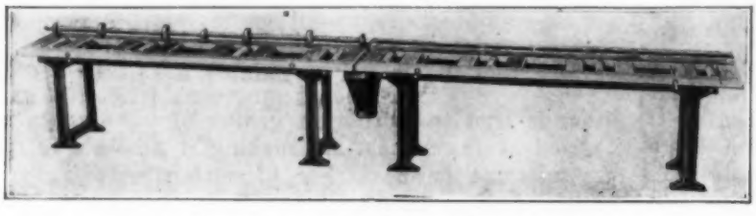
Either inclined or vertical stream types of bubbler can be furnished, the type illustrated having an elliptical bowl with an inclined stream and a cowl to guard it. Other features claimed for the device are the use of a cork-insulated cover, an air chamber surrounding the tank and large connecting pipes.

Oliver Swing Cut-Off Saw Table

The Oliver Machinery Co., Grand Rapids, Mich., has placed on the market the swing cut-off saw table shown in the illustration. The table is designed for use with the overhead swing cut-off saw and is 16 ft. long, 19½ in. wide and 30 in. high. The top is made of kiln-dried rock maple with angle-iron girths and the legs are of cast iron.

The table is composed of two parts or sections. On the rear of the right-hand section is mounted the scale rail, which is graduated in eighths of an inch up to 96 in. On the left-hand section is mounted the Oliver No. 419 patent automatic-swing cut-off saw gage which comprises a square rod graduated in eighths of an inch from 0 in. to 96 in. Four automatic malleable-iron stops, one center and two end door holders are mounted in place. The bed of the table carries a set of rollers as shown. A dust chute is fastened between the two sections of the table, having a 6-in. pipe opening connecting to exhaust system.

This table can be used with any overhead swing cut-off saw.



OLIVER SWING CUT-OFF SAW TABLE

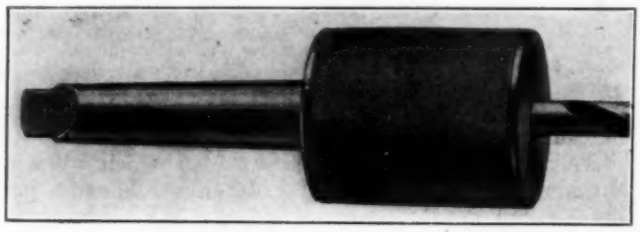
Parker "Shur-Grip" File Holder

The illustration shows the "Shur-grip" file holder which has been placed on the market by the Parker Supply Co., 785 East 135th St., New York, N. Y. The principal feature of this holder is a case-hardened flexible steel thread in the file opening, into which the tang of the file is screwed. This thread is said to cut into the tang like a die and to hold the file absolutely rigid, not only eliminating the usual troubles of keeping the holder on the file, but making it possible to use the holder on different files. A steel casing around the thread prevents it from turning or expanding. This casing and thread are held in the holder by means of a steel ferrule which covers the end of the holder as shown. The handle is made of hardwood. The holders are made in three sizes, for use with files from 6 to 18 in. long.

PARKER "SHUR-GRIP" FILE HOLDER

Eastern Automatic Drill Chuck

The Eastern Tube and Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y., has brought out a drill chuck for use with straight-shank drills. The shank of the drill is held between three cam-shaped rollers, by the simultaneous rotation of which the size of the space for the drill shank can be varied. An internal gear fastened to the sleeve engages with teeth cut on the upper ends of the rollers, so that rotating the sleeve with relation to the shank of the chuck also rotates the rollers. It is thus possible for the operator to change the drill while the spindle of the machine in which the chuck is fastened is rotating, the rotation of the knurled sleeve being retarded with one hand and the drill being removed with the other after it has become loosened. Another drill can then be inserted in the same manner. The cam rollers automatically rotate so as to grip the work, a spiral



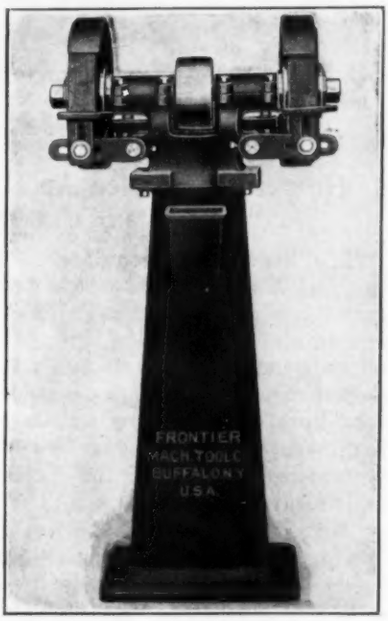
EASTERN AUTOMATIC DRILL CHUCK

spring, which causes the rotation of the sleeve to its normal position as soon as it is released, accomplishing this purpose.

The chuck is said to be self-centering and to be very rapid in its action. There are no screws which can loosen with use, and the presence of oil in the chuck does not prevent the securing of a strong grip. The tapered shank is screwed in place in the chuck, so that it is possible to change it to accommodate the device to different sizes of drilling machines. Morse taper shanks, either Nos. 1, 2, or 3, are ordinarily furnished. The chuck is made in two sizes, the No. 6 size having a range from $\frac{1}{8}$ to $\frac{33}{64}$ in., and No. 8 from $\frac{3}{16}$ to $\frac{33}{64}$ in.

Frontier Tool-Grinder

The illustration shows a tool grinder recently placed on the market by the Frontier Machine Tool Co., Inc., 128 Lakeview Ave., Buffalo, N. Y. The machine is of the ordinary wheel-stand type, is belt-driven and carries two wheels. Guards are furnished for the wheels, and rests for the work. A countershaft can be furnished with the grinder.

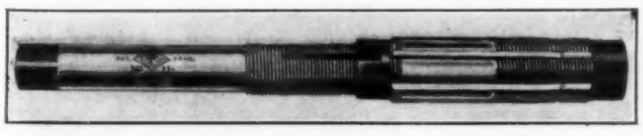


FRONTIER TOOL GRINDER

The wheels are 12 x 2 in. in size and 15 in. apart. The diameter of the spindle is 1 in. between the flanges and $1\frac{3}{16}$ in. at the bearings, the bearings being $4\frac{1}{2}$ in. long. The driving pulley is $4\frac{1}{2}$ x $2\frac{5}{8}$ in. in size. The height to the center of the spindle is 39 in., and the floor space required is 18 x 24 in. The machine without the countershaft weighs 195 lb. net, and 215 lb. crated. The countershaft that can be furnished has a length of 24 in., a drop of 7 in., a driving pulley 12 in. in diameter, and weighs 58 lb.

New Britain Pilot Blade Expansion Reamer

A reamer for use in garages and other shops has been placed on the market by the New Britain Tool and Mfg. Co., New Britain, Conn. The reamer shown in the



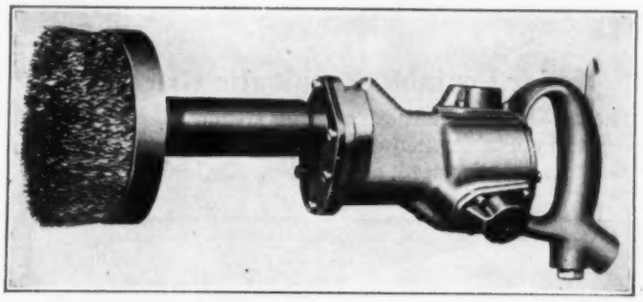
NEW BRITAIN PILOT BLADE EXPANSION REAMER

illustration is of the six-blade expansion type with the entering ends of the blades reduced in diameter to serve as a pilot, to keep the reamer straight, and to prevent "digging" and chattering.

A complete range of sizes from $\frac{13}{16}$ in. to $4\frac{1}{16}$ in. is made. The construction is the same as in the standard expansion reamer manufactured by this company.

Wire Brush for Ingersoll-Rand "Little David" Drill

A wire brush has recently been placed on the market by the Ingersoll-Rand Co., 11 Broadway, New York, N. Y., for use with the standard No. 6 "Little David"



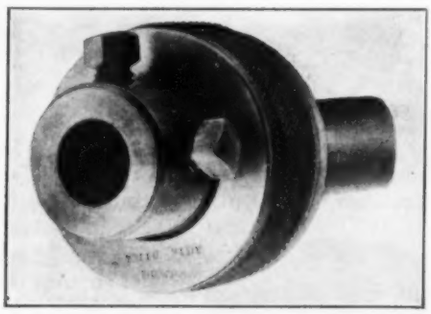
INGERSOLL-RAND WIRE BRUSH ON NO. 6 "LITTLE DAVID" DRILL

drill, on which it is shown in the accompanying illustration. The brush has a face diameter of 5 in. and is made up of wires of a special heat-treated steel, selected on account of its good wearing qualities. It is said to be sturdily constructed, so that it will stand up under severe service. The wire-brush outfit is adapted to the removal of paint, rust, scale and dirt from tanks, steel cars, structural steel and sheet-metal surfaces, as well as to cleaning iron, steel and aluminum castings.

The brush is manufactured particularly as an attachment for the No. 6 "Little David" portable pneumatic drill, previously described in the *American Machinist*, on page 42, Vol. 53. The drill has large bearings to take up the end thrust, a high-speed motor, and it is of light weight and small size. It can be used in sharp corners and other cramped spaces. The whole outfit weighs only $11\frac{1}{2}$ lb.

Randa Floating Reamer and Counterbore Holder

The Randa Manufacturing Co., 1316 East Jackson St., Muncie, Ind., has recently placed on the market the floating reamer and counterbore holder shown in the accompanying illustration. The device is adaptable for use on automatic screw machines, turret lathes and boring mills, and it can be made to suit any purpose, for reamer shanks of different sizes, either straight or tapered. It is stated that the reamer is always held parallel to the axis of the spindle. A large bearing surface on the end of the floating member holding the reamer fits against a corresponding bearing surface on the body or shank end of the tool. The driving is accomplished by means of a square block fitting into correspondingly shaped recesses in both the shank and the floating member. The wearing surfaces are hardened and ground. It is stated that the device is very accurate, and can work continuously to close limits.

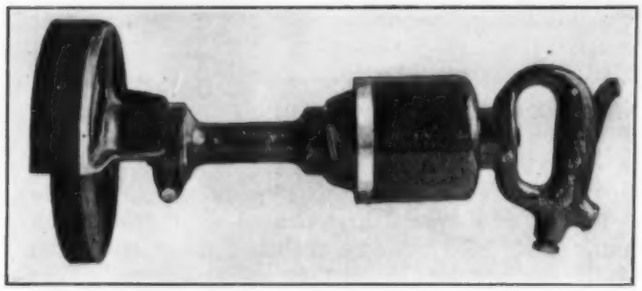


RANDA FLOATING REAMER AND COUNTERBORE HOLDER

The holder is made in three standard sizes, the No. 1 size holding up to ½-in. reamers, the No. 2 size those from ½ to 1⅛ in. in diameter, and the No. 3 size reamers above 1⅛ in. The maximum outside diameter of the device is, for the respective sizes, 1⅝, 2½, and 3¼ in.; and the diameter of the reamer shank is ⅜, ⅝ and 1 in. The two larger sizes are made so as to provide oil feed for the reamer.

Keller Portable Pneumatic Grinder

The Keller Pneumatic Tool Co., Grand Haven, Mich., builds the portable pneumatic grinder shown in the illustration and designated as the No. 22-G machine. Its



KELLER PORTABLE PNEUMATIC GRINDER NO. 22-G

motor is of the rotary-piston type running at the proper speed for grinding, and it is stated will maintain its speed under load. The construction eliminates crankshaft and connecting-rod thrust, and thus any vibration that might be due to these parts.

The object of the design has been to develop a tool that will be both handy and well-balanced, it is said, thus lightening the strain on the operator. The tools are built in two sizes, the smaller weighing 5¾ lb. and the larger, 18 pounds.

Osgood Safety Filegrip

A grip for use on the outer end of a file has recently been placed on the market by the J. L. Osgood Tool Co., 43 Pearl St., Buffalo, N. Y. The accompany-

GRIP IN PLACE ON A FILE

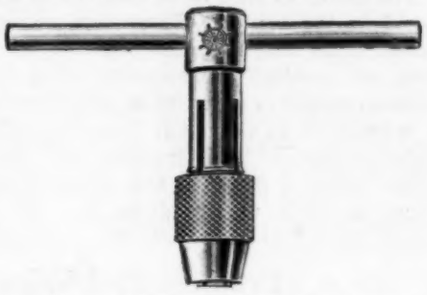
ing illustrations show both the grip itself and the manner of attaching it to the file. The device is made of rubber, and is pliable and soft, so that it both holds itself in place when slipped on the end of the file, and also prevents cutting and soreness of the hand which occur from constant pressure on the file teeth.

OSGOOD SAFETY FILE-GRIP

It is stated that the use of the grip enables the holding of the file flat on the work, and also enables the production of better work with less effort than required without the grip. The grip can be used as a soft-face mallet for light driving on finished surfaces. In case the file be dropped, the cushioning action of the grip prevents breakage of the file or injury to the work on which it may strike. The grip is made for all sizes and shapes of files.

Consolidated Adjustable Tap Wrench

The Consolidated Tool Works, Inc., 296 Broadway, New York, N. Y., has recently placed on the market the adjustable tap wrench shown in the illustration. The tool is made from solid bar steel, and is ground and polished to a finish. It is said to be a very handy wrench, being quickly and easily adjusted, by means of the threaded collar, for holding different sizes of taps, drills, reamers, wire and other articles. The wrench is made in two sizes, the No. 70 tool holding taps up to ¼ in. in size, and the No. 80 up to ½ in. taps.



CONSOLIDATED ADJUSTABLE TAP WRENCH

How a Fly Spoiled An Expensive Job

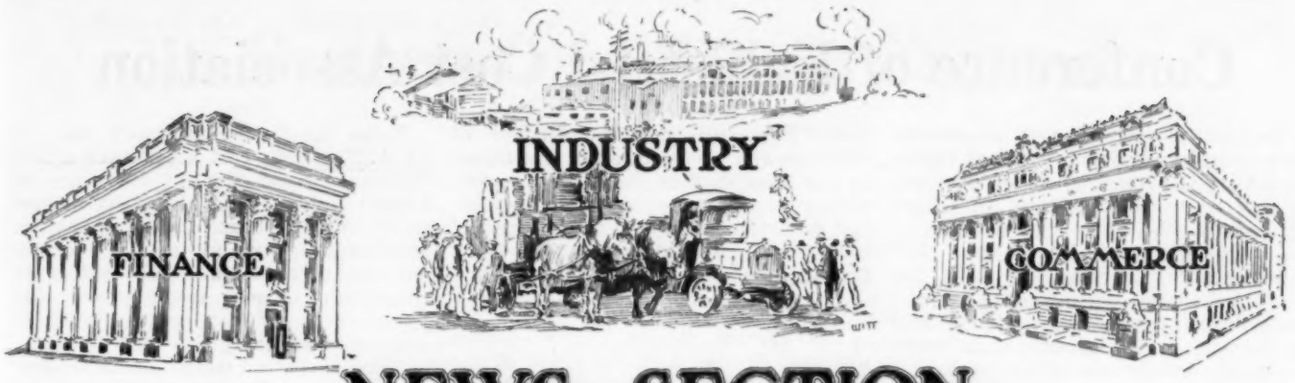
BY ALONZO G. COLLINS

While browsing through the back volumes of the *American Machinist*, the article entitled "In Retrospect," by Matthew Harris, on page 1259, Vol. 50, concerning the origin of blueprinting, brought to mind an incident that happened in the early 80's. A tracing, a fly, and a blueprint were the cause of considerable expense to the proprietors of one of the machine shops in the Middle West, who were not using blueprints for their work.

I was connected with the machinery end of a large manufacturing plant being built in Chicago, and part of my duties consisted of visiting the various concerns which had contracts for supplying machinery and seeing that the work was coming on in schedule time and according to blueprints furnished them by the purchaser.

The shop in question had the contract for shafting, pulleys and other power transmission machinery, among which were several pulleys 14 ft. in diameter and 38 in. face and on one of my visits to the plant I found some of them finished and one on the mill being machined. I got out my note book to make a note of the date and on comparing the size as given in my book and the casting as it stood, I noted that the pulley was 3 ft. 8 in. face instead of the 38 in. called for. I asked the operator for an explanation and he said it was according to the blueprint, which he showed me, and sure enough it was as he said; but there was a queer look about the figures that made them seem unusual, and a closer inspection showed that the "foot" mark after the figure three was a round dot instead of the usual dash. The figures also, were not spaced as far apart as usual, nor was there any dash between them.

I called on the management and reported the facts. They were inclined to be a little "uppish" about it, but a glance at the contract showed that they had contracted to furnish 38-in. face pulleys and there was no way out of it but to scrap them and make new ones. An internal flange on each edge of the face precluded turning them down. On my return to Chicago an investigation showed that a fly had, with a fly's usual disregard for consequences, placed a dot right after the 3, which a careless draftsman had placed farther from the 8 than was needed, and the blueprint paper had copied it faithfully.



NEWS SECTION

Longworth Resolution for Quick Action on Tariff

Few pieces of legislation have given rise to as much discussion as has followed the reporting out of Representative Longworth's resolution to give immediate effect to the permanent tariff bill directly after its being completed by the Committee on Ways and Means. The object of the resolution is to prevent large losses of revenue to the government during the time the revenue bill is under discussion. When the proposed higher rates of duty become known importers bring in large quantities of goods in anticipation of the higher rates. The larger loss of revenue always has been regretted but Congress never has been willing heretofore to give immediate effect to legislation previous to its having gone through the usual course. There is evidence that there will be no departure from this precedent, but nevertheless there is certain to be a very determined effort to secure such legislation. It is admitted by all who favor a protective tariff that this would be of incalculable benefit to American manufacturers, but it is very doubtful if the Senate will accept such a proposition.

Great Britain, France, Italy, Canada, Australia and other governments follow such a procedure. It requires from five to nine months for tariff legislation to take its regular course through Congress. Representative Longworth, in reporting his resolution, declared that between the dates of reporting a revenue bill to the House and of its final enactment into law, the loss of revenue resulting from the artificially stimulated imports will run into hundreds of millions of dollars "at a time when the Government is in need of revenue, as never before and when the resulting damage to American industries would be incalculable."

Bids for Pumping Machinery

Bids are being received by the board of public works at East Chicago, Ind., for the installation of centrifugal pumps of a total capacity of 75,000,000 gallons of water daily and all machinery connected with the pumps, which will be used for a sewage pumping station. The work is estimated at $131,000 and bids will be opened June 13.

Some Export Orders

C. C. Bradley & Son, Inc., Syracuse, N. Y., has recently filled foreign orders for some power hammers of the standard type made by the concern. The principal order, which was shipped during the latter part of May, comprised six cushioned helve hammers, and was consigned to Calcutta, India. Recently one machine was sent to Valpariso, South America, and three to Southampton, England, these being upright helve hammers.

Kimball Slated to Head A. S. M. E. During 1922

Dexter S. Kimball, dean of the college of Engineering of Cornell University, was nominated for the presidency of the American Society of Mechanical Engineers in the report of the nominating committee for 1921, submitted to the society's council on Tuesday, May 24, at the Spring Meeting of the Society held in Chicago.

Dean Kimball, who was elected a member of the society in 1900, was chosen manager in 1919. His term as manager does not expire until 1922 and W. S. Finlay, Jr., of New York City, has been nominated to serve the remainder of the term. Dean Kimball has been active in the work of the society, having been chairman of the Committee on Meetings and Programs and member of the Committee on Organization. He is a vice-president of the Federated American Engineering Societies.

Three vice-presidents were also nominated. They are Col. E. A. Deeds, of Dayton, Ohio; Robert Sibley, of San Francisco; and L. E. Strothman, of Milwaukee. Sherwood F. Jeter, of Hartford; Horace P. Liversidge, of Philadelphia; and Hollis P. Porter, of Tulsa, Okla., have been nominated as managers in addition to Mr. Finlay. William H. Wiley, of New York City, has again been nominated as treasurer. He has occupied this office, having been regularly nominated and elected each year, since 1884.

The nominations, all of which were approved by the council, will be voted on by the members of the society through a letter ballot and the election will take place at the annual meeting next December.

Organization of Technical War Service Officers

In connection with the organization, under the direction of General Pershing, of the reserve armies of the United States, it is proposed to informally associate members of the Army Ordnance Association and the Ordnance Officers of the Reserve Corps.

The membership of the Army Ordnance Association, of which Benedict Crowell is president, is comprised of some twenty-four hundred technical and business experts who, during the war, served either as officers of the Ordnance Department or as executives of industries engaged in ordnance manufacture.

For the purpose of offering assistance in the organization of the reserve armies and in the solution of local war plans, it is now proposed to form in the Metropolitan District of greater New York, a local organization of the Army Ordnance Association which shall include as members all Ordnance Officers of the Officers' Reserve Corps.

Organization Meeting

There will be a meeting for this purpose at the Engineering Societies' Building, 29 West 39th St., at 8 p. m., Wednesday, June 15, with Guy E. Tripp presiding. Short addresses will be made by Maj. Gen. C. C. Williams, Chief of Ordnance; Maj. Gen. Robert L. Bullard, Commanding General of Second Corps Area; Brig. Gen. William Weigel, Chief of Staff, Second Corps Area; Col. Samuel G. Shartle, Assistant Chief of Staff, Second Corps Area; Major M. L. Brett, office of Assistant Secretary of War, and others.

All who served as officers in the Ordnance Department during the war, and all who are interested in ordnance as a factor in preparedness, are invited to attend.

Vocational Board Summer Camp

A summer vacation camp for all trainees of the Federal Board for Vocational Education will be held at Fort Sheridan, Ill., from June 15 to Sept. 15 This camp will take care of veterans in the States of Wisconsin, Illinois and Michigan and will be in charge of Charles W. Sylvester, district vocational officer.

Conference of Industrial Cost Association

Various phases of cost accounting were considered at the National Industrial Cost Conference held on May 26, 27 and 28 at the Roycroft Inn, East Aurora, N. Y., under the auspices of the Industrial Cost Association. The conference, which was said to be the first of its kind, was attended by cost accountants representing a wide variety of industries and localities and many nationally known concerns.

The subjects considered were both general and technical. Ideas on present business conditions in relation to accounting were exchanged; the increasing importance of accurate and correct cost accounting in industry was emphasized, and the need for standard practices and a common meeting ground for accountants was brought forth.

Present Cost Problems

The morning session on the 26th was devoted to business and was attended only by the officers and delegates from the local sections. The conference opened in the afternoon with a session treating on "Current Influences on Cost Problems." J. W. Stannard, secretary-treasurer of the American Autoparts Co., Detroit, Mich., speaking on the subject of "Post-War Changes in Economic Conditions," considered cost accounting from an economic viewpoint. He said that cost accounting as now practiced began only about twenty years ago. The development in Europe and in America followed different lines, which, however, met twelve years ago, so that an international viewpoint can now be obtained on cost accounting. We are at present in the first serious business eruption since that time. No fiscal year has been entirely bad, although 1921, which started poorly, will probably remain so throughout the entire year. Mr. Stannard stated that he expected business in general to remain poor for about eighteen months.

Horace S. Peck, comptroller, S.K.F. Industries, Inc., New York, spoke on the subject of "The Influences of Present Economic Conditions on Cost Practices." He said that above all things freedom from wastefulness must exist. Although the cost department has big problems when business is bad, that is the time when cost systems show their worth. The speaker stated that during good times many businesses did not fortify themselves for the bad times to follow. He stressed the point that retail costs must come to the point where they match the cost of production at the factory. In closing, he stated that to get a proper solution to the present problems unselfishness must prevail; and that no thorough readjustment could arise until labor, capital, wholesaler and retailer are each willing to give what they can to obtain normalcy, rather than to take without giving.

In the discussion which followed the meeting the fact developed that in many lines, although the amount of business and the number of employees in the shop decreased, it was not possible to decrease the size of the accounting department, merely the amount of business and not the amount of detail having been decreased.

Distribution of Burden

The evening session of the opening day was devoted to a discussion of the question, "Should Abnormal Burden Be Included in Current Monthly Cost?" A paper by H. B. Pavitt and W. L. Erdman, cost accountants of the Allegheny Steel Co., Brackenridge, Pa., favored the affirmative, stating that, "Deferring burden does not do away with it. In a time of depression the loss should be shown during the period of non-operation, and not deferred for the purpose of penalizing future operations."

Thomas J. Haley, treasurer of the Fawcus Machine Co., Pittsburgh, Pa., also favored the affirmative, stating that the burden should be distributed in the best and quickest manner, and that the figures should be available to all departments.

A paper by Ernest J. Wesson, industrial engineer of the W. T. Rawleigh Co., Freeport, Ill., favored the opposite side of the question, stating that abnormal burden should not be included in the current monthly cost. He said that, since a business is expected to operate through periods of both good and bad business, it is only the average which counts; he advocated the carrying of a burden reserve on the books of the company.

Lively discussion on the subject of the distribution of burden followed. As a climax to the discussion a vote was taken on the question, the conference favoring, by a majority of three to two, the procedure of not charging up the abnormal overhead against the lessened volume of current production.

Uniform Cost Systems

Uniform cost systems occupied the attention of the conference on the second morning of the meeting. Robert E. Belt, secretary of the American Malleable Castings Association, Cleveland, read a paper on "Uniform Cost Systems and Their Weaknesses from the Trade Association Viewpoint." He favored the adoption of uniform methods of accounting throughout each particular industry, and he said that uniform accounting methods would mean uniform competition and not uniform costs.

"Uniform Cost Systems from the Users' Viewpoint" was the subject of a paper by E. M. Brown, chief cost accountant of the American Blower Co., Detroit. Mr. Brown did not favor the adoption of uniform methods of accounting throughout an industry, because the problems of each plant are peculiar to it, and the accounting system must be built up to suit the conditions.

From the discussion, which was led by A. F. Smith, cost accountant of the National Association of Finishers of Cotton Fabrics, New York, it seemed to be the consensus of opinion that no absolutely uniform systems of accounting can be used, although uniformity of method is very desirable and full co-operation between manufacturers is necessary to secure this uniformity.

"The Standardization of Cost Terminology and Fundamental Principles" was the subject of the afternoon session on the second day, papers being read by Addison Boren, manager of the works accounting bureau of the Yale & Towne Manufacturing Co., Stamford, Conn., and by G. K. Wilson, assistant secretary of the Sullivan Machinery Co., Chicago.

Human Element in Costs

The last general meeting of the conference was held on Friday evening, speakers on the subject of the human element in cost being heard after the banquet. Elbert Hubbard II, president of the Roycrofters, told of activities at his shops. Harry Tipper, manager of "Automotive Industries," New York, spoke on "Measuring Human Costs," stating that the human element is the greatest and most variable one entering into costs, being fundamentally the only cost in industry. The only possibility of making large decreases in costs lies in increasing the productivity of the workers themselves. How to do this is a big problem, as we have but little knowledge on the subject.

"The Profits of the Golden Rule" was the subject of an address by I. H. Mills, superintendent of the Sperry Gyroscope Co., Brooklyn, N. Y. Mr. Mills told of happenings in his long experience in the machinery industry which give him an understanding of the problems of the worker and a groundwork for the treatment of them. Fairness is the item of greatest importance, and personal contact with the men probably of second rank, although kindness, firmness and intelligence are necessary. Mr. Mills favored the open shop and the recognizing of individual merit by the pay check.

In the session on the morning of the 28th, M. F. Simmons, assistant manager of the General Electric Co., Schenectady, N. Y., resigned as president, but remained as a director of the association. J. W. Stannard of Detroit, who presided at the conference, was elected to succeed him. A. A. Alles, Jr., will continue as secretary-treasurer, with offices at 1501 Peoples Bank Bldg., Pittsburgh, Pa. The executive committee appointed consists of Mr. Stannard, H. S. Peck, of New York, and G. K. Wilson of Chicago. Mr. Peck was made chairman of the committee to arrange for a conference of the association next fall. Addison Boren of Stamford, Conn., was made chairman of a committee to write a lexicon of cost terminology, one member of this committee to be nominated from each local section.

Business Conditions in England

By Our London Correspondent

In a strike-ridden country the German agreement to the Allied terms, complete though it appears to be, made but little commotion, for the really significant fact is the steady decline in trade and industry. The latest figures of unemployment are eloquent, showing that at the end of April in Great Britain and Ireland 1,853,308 people usually employed, were without work, while 1,095,999 were on short time. This, of course, is quite outside the million and more of miners and others, men and boys, who are refusing to work on the terms put forward. The dispute has been actively in existence for six weeks and recently no definite move has been made on either side to bring it to an end, while by spasmodic refusals to handle or transmit coal brought into the country, or taken from one port to another, the railway and transport workers have widened the trouble, more or less deliberately. Once more the object is to demonstrate the solidarity of labor. The train services are restricted in order to save half or even more of the coal usually consumed, and in electrical works something like 20 per cent has been preserved. On the other hand, water consumption has barely declined, the saving here being about 2 per cent. Only emergency services are being run on the railways. Next week on Whit Monday, a holiday when in the past many crowded cheap excursions by rail have been the rule, the Great Eastern Railway is running five trains the whole day, two in the morning from London, and three in the afternoon to London. As to shipping, 1,160 vessels amounting to a total of 1,707,000 net tons, are out of commission indefinitely, the tonnage laid up having something like doubled since last January. Parliament has elicited the fact that during the current year up to the end of April £18,241,200 had been expended in out-of-work donation and unemployment benefit, £13,340,600 from the unemployment fund and the rest as donation from the Exchequer. Expenditure on the special defence force and reserves during the first four weeks of the dispute amounted to about £1,700,000.

Exports Declining

Naturally overseas trading in Great Britain has fallen away. The strike commenced at the beginning of April (the cynic may find it an appropriate date), and during the month the apparent adverse balance of trade rose to rather more than twenty-one million pounds, the value of imports being nearly 90 million pounds and of exports nearly 60 millions, with re-exports exceeding more than eight and one-half millions. Already the prediction is being made that the current month will show yet a further decline. And it has to be recognized that the figures for last month do not indicate the loss to the full extent, for the monthly figures are usually a somewhat imperfect record of trading, though on balance the matter rights itself. The reason is that a margin of time is permitted to traders for notification. Thus as regards imports, particulars have to be given within fourteen days of the arrival of the ship, with a further extension if necessary; on the other hand, such particulars may be given before the vessel actually arrives. Then information as to exports must thus be supplied within six days of the outward clearing. This statement will explain the need for the proviso that monthly returns are always subject to revision. The total figures of trading of course are correct. All that can happen is that part of one month's operations may be held over till the next month.

Meanwhile, as is usually the case in such circumstances, the downfall of coal has been foretold. Boilers having been adapted, oil is raising steam in a number of power stations, on a few locomotives and so on, and that it will displace coal is being predicted by people who are oblivious of the fact that Great Britain does not produce this fuel in anything like sufficient quantities.

Further fiscal difficulties are being placed on overseas trading by the addition of various duties, although in Great Britain it is an article of faith that foreign debts of consequence can really only be paid by means of goods. The "Ter Meulen" scheme for the insurance of international trade credits is explained in a cheap pamphlet issued by the International Credits Office of the League of Nations and published in London. The scheme is put forward as a means of helping firms in many of the European countries who wish to import on credit. Business is for the most part arranged in the ordinary way. The importer then borrows from his own government bonds which are deposited as security, these bonds on completion of the business being handed back to the importer and thus to his own government. The last-named issues the bonds to the value of its revenue-producing assets. The idea is to provide a reservoir of credit and "to mobilize the full credit of the country behind individual traders."

Effects of Coal Strike

Exactly what the coal strike means to the metal industries can be gathered from local reports on the Sheffield steel firms. Hatfields, Ltd., has shut down, and Cammell, Laird & Co. is almost closed down. A fair number of men are still engaged at John Brown & Co., Edgar Allen & Co. is working three days a week, Jessop & Sons are shutting; while the larger departments have already closed at Jonas & Colver, Ltd., the remainder will cease work in a day or two. A few shops are running at T. Firth & Sons, and at Vickers, Ltd., the machine shops are stated to be fairly well employed, but not one of the heavy manufacturing departments is at all busy. At Brown, Bayley & Co., out of the usual 2,000 or so men, about 100 are working.

While most people are resisting, some at any rate are agreeing to reductions in wages, and on the northeast coast the shipyard trade unions have voted, on the recommendation of their officials, by a relatively small majority, in favor of acceptance of proposals involving a reduction of 6s. a week, to be effected in two steps. The engineering dispute is just reaching a head, and all signs point to a very definite resistance to the employers' proposals for a marked decline in wages. The difference has in fact been estimated to mean 12½ million pounds a year to members of the chief engineering trade unions, doubtless on the assumption of at least full time working.

Meanwhile some balance sheets of ordinary engineering firms do not provide pleasant reading for shareholders. Thus the net profit of Clayton and Shuttleworth, Ltd., Lincoln, for last year, after making various allowances, amounted to £40,036, comparing with £77,715 in 1919. Trade and labor difficulties and the general falling-off in demand are the reasons ascribed for the reduction of profits. It is announced that a working agreement has been reached with Hofherr-Schrantz-Clayton-Shuttleworth, of Vienna and Budapest, with a view to the recovery of trade in eastern Europe and Russia. Beyer, Peacock & Co., Ltd., the Gorton locomotive engineers, after making various adjustments, declared a loss on working for last year of £17,270. A year ago the dividend paid to the shareholders was 10 per cent.

Turning to the motor car firms, Rolls-Royce, Ltd., shows a net profit of £202,-552, comparing with £192,296 the year before. Nevertheless in view of the times the dividend has been reduced from 15 to 10 per cent. It may be mentioned that £40,000 has been allocated to the workers' welfare fund. Then, in confirmation of many rumors, it has been stated that pending arrangements for the reorganization of the company's finances Sir Arthur Whinney has been appointed receiver and manager of the Austin Motor Co. A loan has in fact been privately arranged, subject to agreement by the creditors. Price reductions continue to be advertised. The Overland has been dropped from £495 to £395, the Chevrolet from £450 to £330, the Zebra (French) from £395 to £325, the Talbot-Darracq from £850 to

£750 and the Charron from £1,100 to £750.

Electrical engineering is certainly a branch of British industry which was, so to speak, placed on its feet as a result of war operations. The fact is evident in the reports that have recently been issued. The Metropolitan-Vickers Electrical Co., Ltd., for example, showed a net profit of £83,231 greater than the corresponding profit of 1919, the orders received during 1920 being in value about 80 per cent greater, while orders completed were about 50 per cent greater than those of the year previous. Then the English Electric Co., Ltd., showed net profits amounting to £266,936, comparing with £180,835 the year previous. The Brush Electrical Engineering Co., with a financial past of unusual interest, has reported a net profit of £191,100, comparing with £148,700 for the preceding year. The dividend remains at 15 per cent, but as part of the reserve was capitalized and issued as a share bonus the dividend is really 30 per cent on the old capital. Siemens Bros. for the fourth year paid 10 per cent, income tax free, also on an increased capital, and shareholders are to receive as a bonus 300,000 new 10 per cent preference shares, one new share for each five existing shares. The proposal has been criticised for it has been decided to create a million of these shares, which would of course take precedence over the ordinary shares. As to British Thomson-Houston Co., Ltd., capital reorganization has been effected, with the result that the ordinary shares receive a dividend after 18 years. The profit declared on last year's working is £470,470, comparing with £412,400 the year previous.

With nearly all industries paralyzed, the machine-tool trade is hardly likely to be an exception. Indeed in this branch the home demand does not exist and such orders as are being received are for overseas. Very few firms are even moderately employed, though it may be mentioned that the Lang firm of Johnstone is still reasonably well engaged on lathe orders that have yet to be completed. Still, current conditions will not be allowed to prevent preparation, and among inquiries are certain ones in connection with the Brunner Mond chemical works in the northeast of England which will have its own self-contained engineering workshops, at a cost of a quarter of a million pounds. The necessary inquiries have been issued, the shops, as at present proposed, being apparently based on a continental model.

Mechanical Tillage in East Indies

In a recent issue of *Eastern Engineering*, it is reported that investigations have shown that on the Java sugar estates those areas which have been plowed by machinery have yielded more cane, as well as more sugar, than other areas. Sugar experts are now urging the industry to establish a bureau for the study of mechanical tillage on the various estates.

The Swiss Machinery Industry in Critical Condition

The Swiss machinery industry is at present in a critical state. Considering the fact that Switzerland has to import every pound of coal and iron for her industries, it is certainly remarkable that in spite of these drawbacks the country has been able not only to build up a machinery industry of considerable importance, but also to gain a strong foothold in foreign markets. This is especially the case in the electrical industries. At present, however, the consequences of foreign competition are being seriously felt and Swiss manufacturers declare that under present conditions they are no longer able to carry on manufacturing with any prospect of success. This is chiefly due to the high cost of production and high wages for labor. Only a considerable reduction of these two items will enable the Swiss machinery manufacturers to continue their business. In comparison with wages paid in other neighboring countries the Swiss rates are simply prohibitive. This may be seen from the following table.

In February last wages paid per hour in Germany were as follows:

(a) For Time Workers	
Toolmakers	155 to 637 pfennigs or 14 to 57 centimes in Swiss money
Blacksmiths	169 to 578 pfennigs or 15 to 52 centimes in Swiss money
Metal molders	219 to 434 pfennigs or 20 to 39 centimes in Swiss money
Turners	188 to 462 pfennigs or 17 to 42 centimes in Swiss money
(b) For Piece Workers	
Helpers	113 to 512 pfennigs or 10 to 46 centimes in Swiss money
Machinists	276 to 553 pfennigs or 25 to 50 centimes in Swiss money
Iron molders	225 to 653 pfennigs or 20 to 59 centimes in Swiss money
Stokers	262 to 502 pfennigs or 24 to 45 centimes in Swiss money

In Switzerland, however, the average wages paid in the metal and machinery industries (per hour) are:

	1914	1920
Skilled labor	0.72	1.90 francs
Unskilled labor	0.55	1.60 francs

Though wages have increased in Germany since the outbreak of the war by 500 to 600 per cent, as against only 140 to 180 per cent in Switzerland, the cost of production in Germany, on account of the depreciation of the mark value by more than 90 per cent, is only half of the cost of production in Switzerland.

The great movement now on foot in Switzerland to induce the government to restrict the imports to a certain extent is not at all supported by the majority of the Swiss manufacturers, who believe that such steps will only be followed by similar reprisals on the part of foreign countries. The only way to better the present conditions is the reduction of the cost of production and wages. It is well understood that this is not an easy matter, especially as prices for all necessaries of life and foodstuffs are higher in Switzerland than in any of the other industrial countries. It is further pointed out that numerous Swiss industries are still working with antiquated machines and tools and that the eight-hour day officially introduced by the government has already led to untenable conditions.

In conclusion, some figures may be of interest: In 1913 the exports of Swiss machinery amounted to 561,238 metric quintals (a metric quintal equals 50 kilograms, approximately 100 pounds), valued at 98,734,890 francs; in 1912 to 649,696 metric quintals, valued at 276,434,002 francs. In normal times the Swiss machinery industry exported 50 per cent of its entire production.

Weights and Measures Conference

The discussion of legislation providing for the compulsory adoption of the metric system, which was scheduled to take place at the weights and measures conference in Washington, May 23 to May 26, was omitted from the program and a resolution was passed instructing the executive committee of the organization to make this subject one of the major items on the program at next year's meeting. The resolution specified that the subject should be listed on the program not later than the second day of the conference so as to insure the presence of most of the delegates.

The fact that the conference should put the matter over until the next meeting is regarded as evidence that its members do not anticipate any effort to take the metric bill up for final action within the next year.

Secretary Hoover, in his address, emphasized particularly the need for standardization and simplification of packages. This, he said, would result in a great saving when it is computed on the entire volume of the nation's output of goods in package form. If the United States is to compete for foreign trade, its industries will have to resort to all manner of thrift in order to meet the prices of foreign producers who will have the advantage in several matters of cost.

It was brought out at the meeting that the specifications of liquid-measuring pumps have been revised to the point where they now are regarded as being entirely workable and capable of being enforced.

Among the resolutions adopted was one approving the principle of serialization of types of weighing and measuring devices in common use, and favoring the passage of legislation giving the Bureau of Standards power to put into effect such serialization. In another resolution, the conference approved the recommendations of Secretary Hoover in regard to standardization and simplification of containers. Representative Haugan's slack-filled package bill was endorsed in another resolution.

Southern Metal Trades to Convene at Asheville

The fourth annual convention of the Southern Metal Trades Association will be held this year at Asheville, N. C. The meeting will run over two days, June 13 and 14, and will have its headquarters in the Battery Park Hotel.

Several interesting papers have been prepared for presentation, among which are: "Pressing Industrial Questions," by Magnus W. Alexander, managing director of the National Industrial Conference Board, New York; and "Idleness and its Relation to Industry," by T. W. Dinlocker, of the S. K. F. Industries. An old-fashioned barbecue and a sightseeing auto trip are on the social program.

William T. Harding, president of the association, has sent out an urgent call for all members to be present at this year's convention.

Prize for Hardness Test Machine

Sir Robert Hadfield, to whom the John Fritz Medal for his invention of manganese steel will be presented at the opening meeting of the British Institution of Civil Engineers on June 29 in England, has offered a prize for the best design of an apparatus to determine the hardness of material accurately and suitable for application in metallurgical work for cases in which present methods partially fail, according to an announcement just made here by the American Society of Mechanical Engineers. Drawings or models should be patented and submitted by the close of the current year.

Resumption of Production a Sign of Better Times

During the past week we have received several reports that indicate improvement in business.

It is reported that seventy-five men were called back to work in the Vandalia machine shops at Terre Haute, Ind.

The Universal Machine Co., which occupies a part of the Industrial Building, Baltimore, Md., is reported as working full time with the possibilities of putting on a night shift.

A. F. Rockwell, president of the Standard Steel and Bearings Co., at Plainville, Conn., has issued a statement to the effect that the company will resume operations as soon as a productive force can be assembled.

The Waterbury (Conn.) plant of Robert H. Ingersoll & Bro., which closed some weeks ago, is reported as having re-opened last week with a full force.

Other similar reports, coming from widely separated sections of the country, are taken as omens of better times ahead and the gradual resumption of normal conditions in industrial enterprise.

Business Items

The Baldwin Chain and Manufacturing Co., of Worcester, Mass., has absorbed the Arcade Malleable Iron Co., of Worcester, Mass., and the business will be continued with the former name. The capitalization of the new company consists of $750,000 in common stock and $300,000 in first mortgage bonds. The bonds were authorized to finance the combining of the two companies. The officers of the new company are: George T. Dewey, president; William F. Cole, vice-president; James H. Kendall, vice-president; William H. Rockenfield, general manager; William H. Gates, treasurer, and H. P. Blumnauer, vice-president and general manager of the Arcade Malleable Iron plant. All the above are directors of the concern also.

Articles of incorporation for the Baldwin-Hall Co., Inc., of Syracuse, N. Y., have been filed with the secretary of state. The capital stock is $50,000 and the company will manufacture electrical machinery. William H. Hall, Jr., Harley J. Crane and Fred. S. Baldwin are named as incorporators.

In order to co-operate more closely with their jobbers in the Middle West the Black & Decker Manufacturing Company, Baltimore, Md., has opened a Kansas City branch office at 1711 Grand Ave. This branch will serve Kansas, Nebraska, Oklahoma, Texas, Arkansas, western Louisiana and western Missouri, and will be in charge of J. N. LaBelle, formerly assistant manager of the Chicago branch. Mr. LaBelle will be assisted by Emery Harris, who will make his headquarters at Omaha, Neb., and R. Brice Shipley, who will cover Oklahoma, Texas, Arkansas and western Louisiana.

Joseph Beal & Co., Boston, Mass., is selling out a complete line of machinery which is located in a branch warehouse at Springfield, Mass. This warehouse is to be razed to make way for a new bridge, necessitating the removal of the Beal stock.

The Buyers Machine Co., of Ravenna, Ohio, has opened direct sales offices in New York and St. Louis. F. W. S. Elmes is district manager in charge of the New York Office, which is located at 30 Church St., and Frank E. Miner is district manager in charge of the St. Louis office at 700 Rialto Building.

The Hendey Machine Co., Torrington, Conn., has increased its working schedule to five days a week, ten hours per day. A number of new orders have been received necessitating the resumption of the fifty-hour week schedule.

The Viking Pump Co., Cedar Falls, Iowa, held its annual banquet, in honor of the employees, on May 14. The feature of the evening was the presentation of bonuses to employees who have served more than one year. George Wyth, manager, made the presentations, which totaled over $3,500.

The Blackburn Gear Shift and Steering Wheel Co., St. Louis, Mo., has been incorporated, and has purchased the plant of the Central Insulating and Moulding Co., in that city. It is reported that production will begin at once.

The Federal Machine and Welder Co., Warren, Ohio, announces the following changes in the personnel of the organization: A. E. Hackett is placed in charge of the Detroit, Mich., office and Stanley Mazure, Jr., will assume supervision of the Chicago office.

The Purves Manufacturing Corporation has been organized at Syracuse, N. Y. Articles of incorporation have been filed naming J. A. Purves, W. C. Purves, J. M. Purves and C. S. Carr as directors. The capital stock is reported at $40,000.

The building and improvement work on the plant of the American Rolling Mill Co., at Middletown, Ohio, has just been completed at an estimated cost of $3,000,000. The work was done under the supervision of the Dwight P. Robinson Co.

The Styer Manufacturing Co. has been incorporated at Dayton, Ohio, with a $50,000 capital, to manufacture articles from metal. Directors are John Fitzgerald, Louis Gianopuios and George W. Styer.

The Fulton Pit Car Co. has been incorporated with $325,000 capital by C. K. Myers, H. N. Myers, J. V. Dugan and D. Baughman. This company will maintain its factory at Canal Fulton, Ohio.

For the purpose of manufacturing setscrews and other small goods, together with small machine tools, the Muncie Cap and Set Screw Co. has been organized at Muncie, Ind., with a capital stock of $250,000. The company has incorporated under Indiana laws. The men interested in the company are John Stetter, William Wuthenow and Abe Feinberg, all of Muncie.

Byproduct machines for meat packers and renderers and general packing house equipment will be manufactured by the G. & W. Manufacturing Co., Dayton, Ohio, which was recently incorporated with $50,000 capital stock. The company will soon be in the market for all kinds of boiler shop equipment. Incorporators of the company are A. J. Welty, J. J. Gage, C. F. Canny, R. E. Kneisly and L. E. Smith.

Construction of a factory building 60 x 135 ft. to house the newly organized Woods Engineering Co., Alliance, Ohio, has been announced. The company, which has a capital stock of $350,000, will manufacture automatic jacks. F. C. Woods is president and general manager, and F. A. Hobbs secretary and treasurer.

Announcement is made of the formation at Barberton, Ohio, of the Grant Quick Ice Machine Co., organized for the purpose of making ice machines for commercial use. The new company has a capital stock of $25,000.

Edward M. Moore, David E. Cook and C. J. Williamson, all of Redkey, Ind., have organized the Hoover Tool Co., a retail establishment that will deal exclusively in tools of all descriptions. The company has a capital stock of $10,000.

The Keuthan Foundry Co., Middletown, Ohio, recently was incorporated at Columbus, Ohio, with a capital stock of $100,000, and will engage in general foundry business in Middletown. The company plans to erect a modern steel and brick foundry building which is expected to be ready for operation the latter part of the summer. C. C. Keuthan and L. Keuthan are named the incorporators of the company.

The McCormick Machinery Co. has removed its warehouse from Queen St. to 47 Murray St., Montreal, Canada.

The Shepard Elevator Co. has been organized at Cincinnati, Ohio, and will be incorporated with a capital stock of $100,000. The incorporators include Oscar F. Shepard, Stanely M. Rowe, Robert Hilton, Ralph R. Caldwell and Frank M. Andrews.

The Motch and Merryweather Machinery Co. of Cleveland, Ohio, has taken over the sales of the Gordon cam turning lathe, which is now being manufactured by the Willard Machine Tool Co. of Cincinnati, Ohio.

The Lucius Manufacturing Co., Canton, Ohio, has changed its name to the Canton Tank and Manufacturing Co. The company is located at 9th and Robin Sts. S. E. Officials said the name was changed in order to include the geographical location of the business as well as to indicate the product manufactured. Officers of the company are: H. H. Dine, president; H. B. Ramey, general manager; J. E. Milner, secretary-treasurer. These men with Edward Zintsmaster, L. A. Koons, William Delaney and A. F. Dieringer compose the board of directors.

For the purpose of manufacturing metal parts of all descriptions, including automobile accessories, steel stamps, stencils, dies, etc., and in addition to manufacture mirrors, art glass, plate, etc., the Victor Products Co., Springfield, Ohio, was recently incorporated with a capital stock of $15,000. The company has a large modern factory building and plans to add considerable machine-tool equipment. Officers of the company are: President, John A. Cadle; vice-president, E. E. Stanford; secretary-treasurer and general manager L. B. Lemmon.

The Rogers Faucet Co., 36 River St., Bridgeport, Conn., manufacturer of "Rogers Faucets," has recently filed a certificate with the Secretary of State of Connecticut, increasing the capital stock of the concern from $150,000 to $450,000, to be used in increasing production, etc. The company recently started production in the plant on River St., on the Berkshire Pond, Bridgeport.

Personals

B. B. BACHMAN, chief engineer of the Auto Car Co., Ardmore, Pa., was chosen by the nominating committee to be president of the Society of Automotive Engineers for 1922.

COLONEL WILLIAM C. SKINNER has resigned as president of the Colt's Patent Fire Arms Manufacturing Co. to become chairman of the board of directors. Samuel M. Stone was elected in his place.

ARTHUR J. LITTLEJOHN, secretary of the Meldrum-Gabrielson Corporation, of Syracuse, N. Y., has been elected treasurer of the Knapp Pattern and Castings Corporation, also of Syracuse.

RAY J. SUTHERLAND, formerly welding engineer with the Davis-Bournonville Co., has taken over the management of the Sisterville Welding Co., Sisterville, W. Va.

J. F. SCOTT, of Cleveland, Ohio, has been appointed general manager of the Alloy Foundry Co., Warwick, Ohio.

W. H. JOHNSON has been named receiver of the Dart Truck and Tractor Co., Waterloo, Iowa, and has furnished a bond for $150,000.

H. J. WILSON, until recently connected with the Fairbanks Company of New York, and stationed at the New Orleans branch, has joined the Gulf Machinery and Ship Supply Co., of Galveston, Texas, as sales manager. The Gulf company will specialize in machine tools, crude oil engines, valves, fittings and similar supplies.

C. R. BURT, until recently with the Davenport Machine Tool Co., Rochester, N. Y., is now president and general manager of the New Process Gear Corporation of Syracuse.

G. E. PRICE, JR., has resigned as purchasing agent for the Davis-Bournonville Co., Jersey City, N. J., to accept another position in the Middle-West.

RALPH S. COOPER, vice-president and general sales manager of the Independent Pneumatic Tool Co., Chicago, Ill., has been appointed general manager of the company. He has just returned from Europe, where he went to establish several branch offices and agencies.

GLENN MUFFLY, formerly sales manager of the Lees-Bradner Co., Cleveland, Ohio, has assumed similar duties with the Miller Shock Equalizer Co., also of Cleveland.

ROBERT S. JENSEN, of the sales department of the Gilbert & Barker Manufacturing Co., of West Springfield, Mass., has been transferred from the factory sales offices to the Chicago office, where he will be assistant to Mr. Burrows. Mr. Jensen has been with the company since April, 1916.

E. L. COOLBROTH, SR., and CHARLES E. F. BLAKE, both salesmen for the Gilbert & Barker Manufacturing Co., of West Springfield, Mass., have recently resigned their positions with the company.

CARLOS DELEON, works manager of the Gilbert & Barker Manufacturing Co., of West Springfield, Mass., has recently terminated his services with that company.

H. W. HEINRICH, manager of the Latin-American department of the export division of Yale & Towne Manufacturing Co., of Stamford, Conn., will leave shortly on a trip to South America. Mr. Heinrich expects to be gone from this country six or seven months.

Obituary!

ORAM M. GALE, head of the O. M. Gale Machine Co., Syracuse, N. Y., died on May 13. He was in his fifty-sixth year. Mr. Gale has conducted a machine shop in Syracuse for eighteen years.

F. WILLIAM GARTMAN, formerly vice-president of the York Electric and Machine Co., York, Pa., died on May 3.

C. C. WOLFE, president of the Dart Truck and Tractor Co., Waterloo, Iowa, died May 19 after a short illness. He was actively affiliated with several industries in Waterloo, including the Waterloo, Cedar Falls & Northern Railway.

COLONEL CHARLES M. JARVIS, of Berlin, Conn., died on May 21 at Atlantic City, where he had been convalescing from a recent illness. Colonel Jarvis was a former president of the American Hardware Corporation and was a prominent manufacturer and agriculturist.

KARL G. ROEBLING, president of John A. Roebling Sons Co., builders of the Brooklyn Bridge, died at his summer home at Spring Lake, N. J., May 19.

Forthcoming Meetings

The American Railway Association will hold the Spring meeting of its Purchases and Stores Section at the Blackstone Hotel, Chicago, June 9 to 11, and the Spring meeting of its Mechanical Section at the Drake Hotel, Chicago, June 15 and 16.

The fourth annual convention of the Southern Metal Trades Association will be held in the Battery Park Hotel, Asheville, N. C., on June 13 and 14. W. E. Dunn, Jr., Candler Bldg., Atlanta, Ga., is secretary.

The 1921 annual meeting of the American Society for Testing Materials will be held at Asbury Park, N. J., on June 20 to 24, with headquarters at the New Monterey Hotel. C. L. Warwick, Engineers Club, Philadelphia, Pa., is secretary.

The eighth annual convention of the American Drop Forge Association and the Drop Forge Supply Association will be held at Chicago, Ill., June 22 to 24 with headquarters at the Congress Hotel.

NEW *and* ENLARGED

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Conn., New Haven—The J. Reynolds Mfg. Co., 99 Mill River St., manufacturer of set and cap screws, etc.—No. 3 or 4 Farrell foundry or Manville solid die heading machine.

Conn., Norwalk—The R. & W. Shop Inc. —One 9 in. swing x 4 ft. bed style "K" Star bench lathe complete with regular equipment.

One 7 in. x 3 ft. Feather bench lathe with long legs, oil pan, countershaft and regular equipment.

Mass., Meridan—J. H. Miner Saw Mfg. Co.—1,500 to 2,000 lb. single acting press.

N. Y., New York (Borough of Brooklyn) T. F. Flynn, Engr., 7801 Ridge Blvd — No. 2½ Bath Universal grinder complete with equipment "A."

N. Y., New York (Borough of Manhattan)—Halpern & Co., 110 West 40th St.—general machine tool equipment for the manufacture of railroad equipment.

N. Y., New York (Borough of Manhattan) —A. G. Schoonmaker & Sons, 25 Church St. (Machinists)—Size "E" 150 lbs., belt driven power hammer.

N. Y., Sidney—M. A. Doolittle Co.—14 in. swing x 10 ft. bed Porter lathe for machine shop.

Pa., Knox—The Bd. Educ.—manual training equipment and shafting pulleys, etc., for school.

La., New Orleans — The Orleans Steel Products Co. Inc., Box No. 274—

George A. Ohl or equal power press or brake and George A. Ohl squaring shear; machines to bend and cut ¼ in. soft. sheet steel size ranging from 7 to 10 ft. 6 in. long.

One gas furnace for tempering dies, medium size.

One Jones & Lamson 2 in. x 24 in. flat turret lathe or its equal.

One American or equal engine lathe, 20 in. swing, 14 to 16 ft. bed, latest model. (New or Used).

Tenn., Knoxville—J. G. Duncan Co., 101 East Johnson St., manufacturer of machinery, J. G. Duncan, Purch. Agt.—24 in. or larger cabinet planer, single surfacer, 8 to 12 in. planer and jointer, 36 in. band saw, 36 in. gauge dinkey locomotive for steam shovel work.

Ill., Chicago—The Ferro Mfg. Co., 3011 South Michigan Ave., manufacturer of auto specialties—small crane, lathe and drill press for its factory at Belvidere.

Ill., Chicago — The Machinery Products Corp., 231 Williams St.—1 in. screw machine.

Ill., Chicago — The Nachman Co., 2241 South Halsted St., manufacturer of springs, S. H. Nachman, Purch. Agt.—1 slitting and winding machine.

Ill., Englewood (Chicago P. O.)—E. E. Hilborn, Mgr. of the Alba Optical Co., 60th St. and Eggleston Ave.—

Bench or precision lathes and drill press. (Used) Lathes must be of draw in spindle type with collets or chucks to take work up to ½ in round stock, and to swing 6 in. Distance between centers, 12 in. or a little more.

Ill., Joliet — The Bd. Educ. c/o J. F. Skeel, Clk., Liberty Bldg.—manual training equipment for school.

Mich., Detroit—The Fitxall Wrench Co., 9353 St. Paul Ave.—miscellaneous equipment for the manufacture of special wrenches.

Mich., Marquette—E. W. Jones and C. P. Frei—repair machinery including drill press and small lathe.

O., Bellefontaine — The Bellefontaine Bridge & Steel Co.—

One 36 in. x 48 in. rotary planing machine for facing ends of columns.

Planer mounted on rotary base.

O., Cincinnati—The Highland Body Mfg. Co., Center Hill Ave., Elmwood—

Blanking and forming press 100 to 120 ton capacity, 66 in. long between housings not less than 30 in. width of bed.

Squaring shear 72 in. long with at least 2 in. or 3 in. gap.

Small size spot welder with 18 in. throat.

O., Cleveland—The Davis Tool Co., 1660 East 118th St.—Davis key seater.

O., Cleveland—J. A. Kilroy & Son, 9407 Ramona Blvd., (Builders)—one air compressor, punches, shears and other tools for fabricating shop. (Used).

O., Columbus—Olco Mfg. Co., 36 West Gay St., manufacturer of oil and auto specialties. N. J. McCumber, 275 North 20th St., Purch. Agt.—machinery for soldering cans and making tin and sheet metal.

Wis., Cedarburg—T. Groth & Sons Co.—drill press, lathe, etc., for garage.

Wis., Milwaukee—J. Biedrzycki, 684 3d Ave.—drill press.

Wis., Milwaukee—The Huebsch Mfg. Co., 366 Brady St., manufacturer of laundry specialties—power sheet metal shears.

Wis., Milwaukee — The Vorecione Mfg. Co., c/o H. A. Schlick, 425 East Water St. —machine tools for the manufacture of metal products.

Wis., North Milwaukee—R. Lahse, Hopkins Rd. (Machinist)—medium size planer.

Wis., Oconomowoc — The Jenkins-Barnhast Motor Co.—small lathe for auto repair work.

Minn., Minneapolis—The Bd. Educ., 305 City Hall, G. F. Womrath, Business Supt. —gas engine and vulcanizing equipment and automobile tools of all kinds for new gas engine room at the North high school.

Mo., St. Louis—T. G. Azar, 840 Choteau Ave.—drill press and lathe.

Okla., Beggs—H. T. Purnell—lathe, steam hammer, drill press, bolt machine, etc.

Cal., Berkeley—The Albany Eng. Wks., 2161 Shattuck Ave., H. T. Coburn—machine shop and foundry equipment.

Ont., Wheatley—H. J. Nelson—general garage and repair shop equipment.

Machinery Wanted

N. Y., Buffalo—Hall's Bakery, 2381 Fillmore Ave., F. G. Kumz, Mgr.—baking machinery and equipment.

N. Y., Poughkeepsie—The Pouvailsmith Corp., manufacturers of rubber compositions, J. H. Branham, Purch. Agt.—rubber mixing machine with rolls up to 36 in. in length.

Ala., Demopolis—The Demopolis Lumber Co., manufacturer of hard-wood and pine lumber. J. C. Webb, Jr., Purch. Agt—8 ft. band mill and a 42 in. edger. (Used).

Fla., Miami—The Atlantic Laundry Co., R. B. Leonard, Genl. Mgr.—$25,000 worth of equipment.

N. C., Burlington—The Chamber of Commerce, J. Vear Mann, Secy.—machinery for the manufacture of furniture, including tenon and mortisers, 4 side planer, drum sanders, glue pots, band and cut off saws, glue vises, etc.

N. C., Junaluska—The Junaluska Supply Co., J. Haner, Mgr.—general planing mill equipment steam pipe and headers for kiln.

Va., Norfolk—L. F. Hobbs, Box No. 483 —one 10 ton, 4 wheel standard gauge locomotive crane single line 45 ft. boom.

Mich., Munising — The Munising Paper Co.—1 traveling crane and 1 locomotive crane.

O., Akron—The Miller Rubber Co., South High St.—

No. 63 Bliss Press, stroke of slide 8 in., width between uprights 20 in., size of bolster 16 in. x 18 in. when stroke is down, 10½ in. from bed to slide, or equal.

O., Toledo—N. T. Thurston, 2509 Parkwood Ave.—stamping equipment for small plant.

Wis., Marinette—The Marinette & Menominee Paper Co., 2311 Riverside — new paper machine, 1 digester.

Wis., Neenah—G. Danke, Main St.—dairy machines.

Ont., Thorndale—The West Missouri Milk Producers' Association, J. Dawson, Mgr.—machinery for making butter, handling cream, etc., and refrigerating equipment.

Japan, Osaka — The Japan Commercial Agency, Itchome, Kyomachiboridori, Nishiku—would like catalogs and prices on stone cutting machines and carpenter's tools.

THE WEEKLY PRICE GUIDE

This Week's Market

The metal market has slipped off a little since last week. Copper and tin are weaker, while lead and zinc have not changed.

The market for shop supplies is very weak, and prices in New York are useful only as a guide.

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$25.50
Northern Basic	25.32
Southern Ohio No. 2	27.52
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	34.26
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25–2.75	26.26
Virginia No. 2	*27.00
Basic	†25.00
Grey Forge	*25.00
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern, sil 2.25@2.75	28.67
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	25.46
Basic	23.96
Bessemer	25.96

* F. o. b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Warehouse Jersey City	New York Delivered	Cleveland	Chicago Delivered
Structural shapes	$3.23	$3.33	$3.09	$3.23
Soft steel bars	3.13	3.23	2.99	3.13
Soft steel bar shapes	3.13	3.23	3.48	3.13
Soft steel bands	4.18	4.28	6.25	
Tank plates	3.23	3.33	3.78	3.23

BAR IRON—Prices per 100 lb. at the places named are as follows:

Mill, Pittsburgh	$2.20
Warehouse, New York, delivered	3.13
Warehouse, Cleveland	3.52
Warehouse, Chicago	3.13

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York,	Cleveland	Chicago
No. 10	3.10	4.25	4.00	4.13
No. 12	3.15	4.30	4.05	4.18
No. 14	3.20	4.35	4.10	4.23
No. 16	3.30	4.45	4.20	4.33
Black				
Nos. 17 and 21	3.75	4.80	4.80	5.20
Nos. 22 and 24	3.85	4.85	4.85	5.25
No. 25 and 26	3.90	4.90	4.90	5.30
No. 28	4.00	5.00	5.00	5.40
Galvanized				
No. 10 and 11	4.00	4.75	5.00	5.70
No. 12 to 14	4.10	4.85	5.10	5.80
Nos. 17 and 21	4.40	5.15	5.40	6.10
Nos. 22 and 24	4.55	5.30	5.55	6.25
No. 26	4.70	5.45	5.70	6.30
No. 28	5.00	5.75	6.00	6.40

COLD FINISHED STEEL—Warehouse base prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb.	$4.73	$4.63	$4.25
Flats, squares and hexagons, per 100 lb.	5.23	4.63	4.75

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent
New York	55%
Cleveland	55%
Chicago	50%

Electric Welding Wire—Welding wire in 100-lb. lots sells as follows, f.o.b. New York: $\frac{1}{16}$, 8½c. per lb.; ⅛, 8c.; $\frac{5}{32}$ to ¼, 7½c. Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York	Cleveland	Chicago
Openhearth spring steel (heavy)	5.50	8.00	8.25
Spring steel (light)	8.00	7.00	10.50
Coppered Bessemer rods (base)	8.00	8.00	6.20
Hoop steel	3.64	3.69	3.83
Cold rolled strip steel	8.00	8.25	7.90
Floor plates	5.30	3.09@3.40	5.78

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card of April 13, 1921:

BUTT WELD

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
1 to 3	62½	50	⅜	33½	18½
			1 to 1½	35½	20½

LAP WELD

2	54½	41	2	30½	16½
2½ to 6	58½	45	2½ to 4	34½	22½
7 to 12	54½	44	4½ to 6	33½	21½
13 and 14	45	37	7 to 8	24½	12½
15	42½	32	9 to 12	19½	7½

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60½	49	1 to 1½	35½	21½
2 to 3	61½	50			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	52½	41	2	31½	18½
2½ to 4	56½	45	2½ to 4	34½	22½
4½ to 6	55½	44	4½ to 6	33½	21½
7 to 8	50½	37	7 to 8	24½	12½
9 to 12	45½	32	9 to 12	19½	7½

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20–5% off.

METALS

MISCELLANEOUS METALS—Present and past New York jobbers' quotations in cents per pound, in quantities up to car lots:

Copper, electrolytic	14.25
Tin in 5-ton lots	32.00
Lead	5.50
Zinc	5.75
ST. LOUIS	
Lead	5.10
Zinc	5.35

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York	Cleveland	Chicago
Copper sheets, base	21.75	22.50	23.50
Copper wire (carload lots)	15.75	17.50	20.00
Brass sheets	17.00	21.00	20.75
Brass pipe	20.75	24.00	24.50
Solder (half and half) (case lots)	24.00	23.50	17.50

Copper sheets quoted, above hot rolled 24 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are in cents per pound at warehouse:

New York	15.00
Cleveland	18.00
Chicago	18.75

NICKEL AND MONEL METAL—Base prices in cents per pound, any quantities, f.o.b. Bayonne, N. J.

Nickel

Ingots and hot	41
Electrolytic	43

Monel Metal

Shot and blocks	35	Hot rolled rods (base)	42
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55

Special Nickel and Alloys

Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grade "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods, "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

SHOP MATERIALS & SUPPLIES

ZINC SHEETS—The following prices in cents per pound are f. o. b. mill less 8% for carload lots..... 10.00

	Warehouse	
	In Casks	Broken Lots
New York	12.00	12.50
Cleveland	11.15	11.50
Chicago	15.75	16.25

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

New York	6.00
Chicago	6.00
Cleveland	7.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	10.00	10.00	$9.00
Copper, heavy, and wire	9.00	9.50	8.50
Copper, light, and bottoms	8.00	8.00	7.75
Lead, heavy	3.25	4.00	3.75
Lead, tea	2.00	3.00	2.75
Brass, heavy	6.00	6.00	9.00
Brass, light	4.50	5.00	5.00
No. 1 yellow brass turnings	5.00	5.00	4.75
Zinc	3.00	3.00	3.00

ALUMINUM—The following prices are spot from warehouse, cents per pound:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	28.4	25.50@26.00	30.00

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current
New York (round)	22.75
Chicago	20.50
Cleveland	22.50

BABBITT METAL—Warehouse price in cents per pound:

	New York	Cleveland	Chicago
Best grade	70.00	43.50	35.00
Commercial	30.00	15.50	9.00

NOTE—Price of babbitt metal is governed largely by formula, no two manufacturers quoting the same prices. For example, in New York, we quote the best two grades, although lower grades may be obtained at much lower prices.

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York	Cleveland	Chicago
Hot pressed square	List	$2.00	1.60
Hot pressed hexagon	List	2.00	1.60
Cold punches hexagon	List	2.00	1.60
Cold punched square	List	2.00	1.60

Semi-finished nuts, $\frac{5}{16}$ and smaller, sell at the following discounts from list price:

	Current
New York	60%
Chicago	50%
Cleveland	75–10%

MACHINE BOLTS—Warehouse, discounts in the following cities:

	New York	Cleveland	Chicago
All sizes up to 1 by 30 in	50–10%	60–10%	50%
1¼ and 1½ in. by 3 in. up to 12 in	50%	50–5%	45%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... $2.00 Cleveland..... $4.00 Chicago..... $4.00
For cast-iron washers, ¼ and larger, the base price per 100 lb. is as follows:
New York..... $4.50 Cleveland..... $3.75 Chicago..... $4.00

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	40%	50–10%	40%
Larger and longer up to 1 in. by 30 in	40%	50%	40%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets	Burs
Cleveland	40%	10%
Chicago	net	net
New York	40%	25%

RIVETS—The following discounts are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel $\frac{1}{16}$ and smaller	50%	60%	45%
Tinned	45%	60%	30%

Structural, ¼, ⅜, ½ in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York...$4.65 Cleveland...$4.60 Chicago....$4.88 Pittsburgh..$3.70

Boiler, same sizes:
New York...$4.75 Cleveland...$4.70 Chicago....$4.98 Pittsburgh..$3.89

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	22.25	25.00	25.50
Brass	20.00	23.00	24.50

Prices vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities less than 25 lb. add 10c. per lb.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ¼-2 in., inclusive in rounds, and ½-1½ in., inclusive in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $0.75.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $7.70 per 100 lb. In Cleveland—$7.00 per 100 lb.; New York price is $7.50.

COTTON WASTE—The following prices are in cents per pound:

	New York Current	Cleveland	Chicago
White	9.00@12.00	12.50	14.25
Colored mixed	6.50@ 9.50	9.50	12.00

WIPING CLOTHS—Jobbers' price per 1,000 is as follows:

	13½x13½	13½x20½
Cleveland	$55.00	$65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current
New York (5 bbl.)	$2.10
Philadelphia (5 bbl)	1.85
Cleveland	3.25
Chicago	2.50

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current
New York (5 bbl.)	$2.55
Philadelphia (5 bbl.)	2.55
Chicago	4.50

COKE—The following are prices per net ton at ovens, Connellsville:

	Current
Prompt furnace	$3.50@$4.25
Prompt foundry	4.50@ 5.50

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	100-lb. bag	$0.80
Cleveland	100-lb. bag	0.80

LINSEED OIL—These prices are per gallon:

	Current		
	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$0.80	$0.75	$0.89
5-gal. cans	.83*	.85	1.14

*Charge of $2.25 for two cans.

WHITE AND RED LEAD—Base price per pound:

	Current		
	Red		White
	Dry	In Oil	Dry and In Oil
100 lb. keg	13.00	14.50	13.00
25 and 50-lb. kegs	13.25	14.75	13.00
12½-lb. keg	13.50	15.00	13.50
5-lb. cans	16.00	17.50	16.00
1-lb. cans	18.00	19.50	18.00

500-lb. lots less 10% discount; 2,000-lb. lots less 10-4% discount; 10,000 lb. lots less 10-7½% discount.

Metal Working

NEW ENGLAND STATES

Conn., Ansonia—The Ansonia Electric Co., 55 Main St., is having plans prepared for the construction of a 2 story, 60 x 200 ft. addition to its manufacturing plant, here. Estimated cost, $250,000. Fletcher Thompson Inc., 542 Fairfield Ave., Bridgeport, Archts. and Engrs.

Conn., East Hartford (Hartford P. O.)—Popp & Wespiser, 24 Willard St., Springfield, Mass., has awarded the contract for the construction of a 1 story, 46 x 80 ft. garage on Main St. and Burnside Ave., here. Estimated cost, $25,000. Noted June 2.

Conn., Hartford — S. F. Hines, 20 Wethersfield Ave., has awarded the contract for the construction of a 1 story, 30 x 120 ft. garage. Estimated cost, $30,000. Noted May 26.

Conn., New Haven—F. T. Herskowitz, 401 George St., will soon award the contract for the construction of a 1 and 2 story garage and work shop on George St. Estimated cost, $15,000. R. W. Fabian, 147 Bradley St., Archt.

Conn., Waterbury—L. N. Albert, 268 South Main St., has awarded the contract for the construction of a 1 story, 50 x 185 ft. garage on North Main St. Estimated cost, $40,000.

Mass., Chelsea—H. Tangard & Son, Willow St., will build a 1 story, 40 x 40 ft. sheet metal shop. Estimated cost, $7,500.

Mass., Clinton—The Payne Garage, Main St., will soon award the contract for the construction of a 1 story, 80 x 90 ft. garage on Main St., here. Estimated cost, $25,000. J. W. Allen, 861 Boylston St., Worcester, Archt.

Mass., Pittsfield—R. M. O'Connell, North St., plans to build a 1 story garage and service station on South St. Estimated cost, $50,000.

Mass., Roxbury—The Danker & Donohoe Co., 462 Brookline Ave., Brookline, has awarded the contract for the construction of a 2 story garage and repair shop on Peabody St. Estimated cost, $100,000.

Mass., Shelburne Falls—M. Ware plans to build a 2 story garage and auto repair shop on Shelburne Rd. Estimated cost, $50,000. Private plans.

Mass., Somerville—The Funk & Wilcox Co., Archts., 294 Washington St., Boston, will soon award the contract for the construction of a 1 story, 40 x 110 ft. milk station and garage on Washington and Myrtle Sts., here, for the Herlihy Bros., Charlestown. Estimated cost, $35,000.

Mass., Springfield—E. Davis, 348 Bridge St., has awarded the contract for the construction of a 2 story, 74 x 182 ft. garage on Chestnut St. and Taylor St. Extension.

Mass., Springfield—P. Quimette, 51 Taylor St., has awarded the contract for the construction of a 1 story, 50 x 60 ft. sheet metal shop on Carew St. Estimated cost, between $7,500 and $8,000.

R. I., Providence—R. E. Arter, c/o C. H. Lockwood, Archt., 171 Westminster St., is having plans prepared for the construction of a 1 story garage and service station to cover 18,000 sq.ft. of floor space on North Main and Frost Sts. Estimated cost, $75,000.

R. I., Providence—P. J. Brennan, Ford and Bucklin Sts., has awarded the contract for the construction of a 1 story garage and repair shop on Ford, Bucklin and Dexter Sts. Estimated cost, $25,000.

MIDDLE ATLANTIC STATES

Md., Cumberland — The Paragon Motor Car Co. Inc., 133 Baltimore St., recently incorporated with $3,000,000 capital stock, plans to build several buildings including a 274 x 300 ft. main automobile building. P. W. Blake, Pres.

MIDDLE WEST STATES

Ill., Belvidere—The Ferro Mfg. Co., 3011 South Michigan Ave., Chicago, will soon award the contract for the construction of a 1 story factory for the manufacture of auto specialties, here. Estimated cost, $60,000. B. Carlson, Archt.

Ill., Chicago—The Guaranty Iron & Steel Co., 2851 West Lake St., will soon award the contract for the construction of a 1 story, 100 x 200 ft. factory on Springfield and Lake Sts. Estimated cost, $65,000. J. A. Taggert, 19 South La Salle St., Archt.

O., Hamilton—The Ford Motor Co., Highland Park, Detroit, Mich., plans to build a 3 story auto assembly plant, here. Estimated cost, $400,000. Private plans.

Wis., Oshkosh—The Oshkosh Tractor Co., c/o A. S. Paive, 22 East New York Ave., is having plans prepared for the construction of a 3 story, 60 x 485 ft. tractor factory. Estimated cost, $250,000. Auler & Jensen, F. R. A. Bldg., Archts. Noted May 19.

Wis., Kiel—The Meili-Blumberg Co., New Holstein, is having plans prepared for the construction of a 1 story, 50 x 120 ft. garage on Main St. Estimated cost, $75,000. W. C. Weeks, 730 Ontario Ave., Sheboygan, Archt.

Wis., Sheboygan—The Dodge Sheboygan Co., c/o W. Y. Dodge Co., plans to build a 4 story, 60 x 180 ft. tractor factory. Estimated cost, $100,000.

STATES WEST OF THE MISSISSIPPI

Minn., St. Paul—The Owens Motor Sales Co., 713 University Ave., will soon award the contract for the construction of a 1 and 2 story addition to present garage. Estimated cost, $80,000. Tolz, King & Day, 1410 Pioneer Bldg., Archts.

Mo., Joplin — The Agrimotor Mfg. Co. will soon receive bids for the construction of a 2 story farm tractor factory and office building on 9th and Illinois Sts. Estimated cost, $100,000. C. W. Lewis, Pres.

Mo., St. Louis—Saum & Saum, Archts., 625 Chestnut St., are receiving bids for the construction of a 1 story, 131 x 150 ft. garage and repair shop on 9th and Choteau Ave., for T. G. Azar, 840 Choteau Ave. Estimated cost, $50,000.

Mo., St. Louis—The Wrought Iron Range Co., 5661 Natl. Bridge Rd., has awarded the contract for the construction of a 2 story, 160 x 272 ft. factory. Estimated cost, $100,000.

CANADA

Ont., Wheatley—H. J. Nelson will build a 45 x 65 ft. garage. Estimated cost, $15,000.

General Manufacturing

NEW ENGLAND STATES

Conn., East Windsor (Warehouse Point P. O.)—The Apothecaries Hall Co., Wholesale Druggist, 63 Bank St., Waterbury, will soon award the contract for the construction of a 1 story, 65 x 140 ft. mixing plant, here. Estimated cost, $30,000. W. B. Reynolds, 95 Bank St., Waterbury, Archt.

Conn., New Haven—The Atlas Bottling Wks., 30 Fair St., will soon award the contract for the construction of a 3 story, 30 x 30 ft. plant on Orchard St. Estimated cost, $10,000. R. W. Fabian, 147 Bradley St., Archt.

Conn., New London—Brainerd & Armstrong Co., 82 Union St., has awarded the contract for the construction of a 1 story, 50 x 50 ft. silk manufacturing plant on Reed St. Estimated cost, $8,000.

Mass., North Andover—M. T. Stevens & Sons Co., manufacturers of Woolens, etc., have awarded the contract for the construction of a 4 story, 53 x 162 ft. factory. Estimated cost, $100,000.

Conn., Norwalk—Foster, Stewart & Co., Inc., 232 Main St., has awarded the contract for the construction of a 1 story, 50 x 165 ft. addition to its awning factory on Main St. Estimated cost, $50,000.

Conn., Waterbury—The Scoville Mfg. Co., 99 Mill St., will build a 1 story, 50 x 96 ft. addition to its brass manufacturing plant on East Main St. Estimated cost, between $18,000 and $20,000.

Mass., Springfield — The Springfield Bronze Co., c/o H. L. Sprague, Archt., 310 Main St., will soon award the contract for the construction of a 1 story, 40 x 65 ft. factory on Cass St. Estimated cost, $10,000.

R. I., Providence—The Sunshine Ice Cream Co., 372 Cranston St., will soon receive bids for the construction of a 2 story, 40 x 80 ft. ice cream manufacturing plant on Cranston and Diamond Sts. Estimated cost $60,000. F. Chiaverni, 117 Bway., Archt. Noted April 14.

MIDDLE ATLANTIC STATES

Pa., Altoona — The Schwarzenbach-Huber Co., 8th Ave. and 25th St., will soon receive bids for the construction of a 2 story, 100 x 160 ft. silk mill on Kettle St., East End. Estimated cost, $75,000. R. Brupbacher, Supt. Noted June 2.

Pa., Waynesboro—M. H. Landis and Associates have organized the Maryland Fibre Products Co., Hagerstown, Md., and plan to build a plant here for the manufacture of fibre products.

SOUTHERN STATES

Fla., Miami—The Atlantic Laundry Co. plans to build a 2 story, 50 x 120 ft. laundry. Estimated cost, $50,000. R. B. Leonard, Genl. Mgr.

Va., Alta Vista—The Standard Red Cedar Chest Co. has awarded the contract for the construction of a 1 story, 60 x 500 ft. manufacturing building. Estimated cost, $125,000.

MIDDLE WEST STATES

Ill., Carthage—The Owings Milling Co., c/o E. Owings, Pres., plans to rebuild a grain milling plant which was destroyed by fire. Estimated cost, $30,000.

O., Marblehead—The Kelly Island Lime & Transport Co., c/o Mr. Price, Purch. Agt., Leader-News Bldg., Cleveland, has had plans prepared for the construction of a 1 story crusher plant, here. Estimated cost, $100,000. Private plans.

Wis., Milwaukee—R. Gumz & Co., 125 Muskego Ave., has awarded the contract for the construction of a 3 story, 32 x 80 ft. addition to its packing plant on Muskego Ave. Estimated cost, $50,000. Noted May 19.

STATES WEST OF THE MISSISSIPPI

Mo., Medill—The Producers Cold Storage Co. has awarded the contract for the construction of a 3 story, 63 x 108 ft. cold storage and packing plant. Estimated cost, $50,000.

Mo., St. Louis — The Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa., plans to build a manufacturing plant on Kingshighway and Sievin Ave. Estimated cost, $1,000,000. Architect not yet selected.

Okla., Bartlesville—E. G. Hanson plans to build a 2 story, 50 x 145 ft. mill building on Second St. Estimated cost, $25,000. J. W. Scott, Archt.

CANADA

B. C., Chilliwack—The Dairy Products Co., Ltd., has awarded the contract for the construction of a 3 story, 40 x 90 ft. factory for the manufacture of powdered milk. Estimated cost, between $40,000 and $50,000.

Que., Montreal—The Standard Paper Box Co., 8 St. Paul St., East, will soon receive bids for the construction of a 5 story, 64 x 196 ft. factory on Park Ave. Estimated cost, $147,000.

Ont., Thorndale — The West Missouri Milk Products Association is having plans prepared for the construction of a creamery. Estimated cost, $50,000. J. Dawson, R.R. 2, Mgr.